Essays on Corporate Cash Holdings

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Vorwort

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Köln, im Juni 2018 Jan Felix Weidemann

Inhaltsübersicht

Teil 1

Motivation und Forschungsfragen

Inhaltsverzeichnis

1. Forschungsrahmen

Zahlungsmittel stellen eine der zentralen Erfindungen der Menschheit dar und begleiten diese seit Jahrtausenden. Frühe Geldformen sind zum Beispiel das Kaurigeld, bestehend aus den Muscheln der Kaurischnecke, Tierzähne, Nutztiere oder Getreide (Davies 2016). Typischerweise wird die erste Verwendung von Münzgeld im Reich der Lyder um ca. 600-700 v. Christus vermutet und insbesondere mit dem Lyderkönig Krösus und dessen Vater Alyattes II in Verbindung gebracht (Schaps 2015). Münzenartige Gegenstände, die hinsichtlich ihres Gewichts und Reinheitsgrades genormt waren und somit allgemein als Transaktionsmittel anerkannt wurde, lassen sich aber bereits 2250 v. Christus in Kappadokien finden (Davies 2016). Die ersten Spuren von Papiergeld können ungefähr im China des 8. Jahrhunderts verortet werden (Rogoff 2016). Der Hauptzweck dieser historischen Zahlungsmittel ist noch heute gültig: Die Vereinfachung der Abwicklung von Handelsgeschäften. Er motiviert zum Teil auch gegenwärtige Trends wie Kryptowährungen, beispielhaft den Bitcoin (Dyhrberg 2016). Geld hat jedoch im Zeitverlauf weitere Funktionen hinzugewonnen, die wesentlich mit der zugrunde gelegten Geldtheorie verknüpft sind.

Bereits in der Antike existierten derartige Geldtheorien. Schumpeter (1965) betrachtet diese theoretischen Ursprünge in seiner „Geschichte der ökonomischen Analyse“ und stellt fest ‚dass diese sich primär mit der Frage beschäftigen, ob der Geldwert von der Beschaffenheit des Zahlungsmittels, also beispielsweise von der Verwendung bestimmter Edelmetalle bei der Münzprägung, abhängt. Dementsprechend vertrat Aristoteles (350 v. Chr.) laut Schumpeter eine metallistische Sichtweise, die den Wert einer Münze allein von ihrem Material abhängig macht, wohingegen Platon (380 v. Chr.) Münzen als Symbol ansieht, deren Wert unabhängig von dem ihnen zugrundeliegenden Material ist.

Eine umfassendere Theorie des Geldes bzw. des Geldwertes stellt die Quantitätstheorie dar, welche bereits von Kopernikus (1517) und Bodin (1568) angedeutet und durch Hume (1752) ausformuliert wurde. Die zentrale Gleichung der Quantitätstheorie besagt, dass das Produkt aus Geldmenge und der Geschwindigkeit des Einkommenskreislaufs dem Produkt aus dem Preisniveau und dem Volkseinkommen entspricht. Hieraus folgt, dass eine Veränderung der Geldmenge die Preisniveaus verändert, wenn die Umlaufgeschwindigkeit konstant ist. Wirtschaftsfaktoren wie die Unterbeschäftigung oder das

volkswirtschaftliche Einkommen sind von diesem Zusammenhang nicht betroffen. Somit wirkt sich die Geldpolitik langfristig nicht auf die Leistung einer Volkswirtschaft aus und verfolgt primär das Ziel, die Abwicklung von Transaktionen zu vereinfachen (Papademos/Stark 2010). Wie auch im Walrasianischen allgemeinen Gleichgewichtsmodell (Walras 1874) ist Geld gem. der Quantitätstheorie kein eigenes Wirtschaftsgut sondern dient als Abrechnungsgut.

Die weitere geldtheoretische Entwicklung wurde durch Keynes (1936) initiiert und über die Keynesianisch-neoklassische Synthese von Hicks (1937) mathematisch ausgedrückt. Sie sieht Geld als eigenständiges Gut an, das nicht nur zur Vereinfachung von Transaktionen existiert sondern auf Grundlage des Vorsichts- sowie des Spekulationsmotives nachgefragt wird. Das Vorsichtsmotiv besagt, dass Geld gehalten wird, um sich gegen unvorhergesehene Ereignisse zu schützen. Dem Spekulationsmotiv folgend wird Geld gehalten, um zukünftige Investitionsgelegenheiten auszunutzen. Die Geldhaltung nimmt also zu, wenn die Zukunft unsicherer ist und keine lohnenden Investitionsmöglichkeiten zur Verfügung stehen, da diese teuer sind bzw. geringe Renditen erwirtschaften. Hier ist ersichtlich, dass die Umlaufgeschwindigkeit des Geldes nicht mehr als konstant angesehen wird. Unter Berücksichtigung der genannten Motive kann also ein Fall eintreten, in dem eine Erhöhung der Geldmenge die nominale Güternachfrage nicht steigert. Zusätzliche Geldmitteln werden also gehortet und nicht ausgegeben. In dieser Situation soll der Staat eingreifen und selber Güter nachfragen, um die Unterbeschäftigung einzudämmen und die Investition des gehaltenen Geldes anzuregen.

Keynes beschreibt folglich eine Situation, in der die Geldmenge und die Geldnachfrage die Produktion, die Beschäftigungsquote sowie das Wirtschaftswachstum beeinflussen, sofern das Preisniveau konstant ist. Somit besteht eine Verbindung zwischen Geldpolitik und der realen wirtschaftlichen Entwicklung. Diese Sichtweise wird vom Monetarismus, beispielsweise nach Phelps (1968) und Friedman (1968), abgelehnt. Dieser erachtet die Arbeitslosenquote als natürlich durch den Arbeitsmarkt gegeben und somit unabhängig von der Geldpolitik. Diese Annahme beruht auf der empirischen Beobachtung, dass die Umlaufgeschwindigkeit des Geldes im Rahmen der Weltwirtschaftskrise ab 1929 nicht gesunken sei (Friedman/Schwartz 1963).

Die dargestellte Auswahl geldpolitischer Theorien versucht die Geldmenge bzw. ihre Wirkung auf volkswirtschaftlicher Ebene zu erklären. Keynes (1936) beleuchtet dabei einige Motive, warum Akteure Geld halten. Die nachfolgende mikroökonomische und betriebswirtschaftliche Forschung vertieft diese Perspektive und untersucht vor allem die Fragen, warum ein einzelnes Unternehmen einen bestimmten Zahlungsmittelbestand (*Cash Holdings*) hält und wie sich dieser Bestand auf den Marktwert des Unternehmens auswirkt. Die zweite Frage betrifft den sogenannten Marktwert der Cash Holdings. Dieser bezeichnet die Veränderung in der Marktkapitalisierung eines Unternehmens als Reaktion auf die Aufnahme einer zusätzlichen Zahlungsmitteleinheit (Pinkowitz et al. 2006).

Die Neoklassische Theorie liefert auf die Frage nach dem Marktwert des Zahlungsmittelbestandes eine klare Antwort: Unter der Annahme eines vollkommenen Kapitalmarktes, auf dem Soll- und Habenzins identisch sind, Kredite in unbegrenztem Volumen aufgenommen werden können, keine Transaktionskosten, beispielsweise in Form von Steuern, Informationsasymmetrien oder Brokergebühren, vorliegen sowie unter der Prämisse des rationalen Verhaltens und homogener Zukunftserwartungen von Investoren, hat Unternehmensfinanzierung keinen Einfluss auf den Marktwert eines Unternehmens (Modigliani/Miller 1958). Dies bedeutet wiederum, dass der Marktwert einer zusätzlich gehaltenen Zahlungsmitteleinheit seinem nominellen Wert entspricht und der Unternehmenswert folglich genau um 1 steigt.

Die Neue Institutionenökonomie beschäftigt sich mit den einschränkenden Annahmen der Neoklassik und setzt diese stückweise außer Kraft. Hieraus resultiert beispielhaft die Prinzipal-Agenten-Theorie gem. Berle/Means (1932) und Jensen/Meckling (1976), welche verschiedene Arten von Informationsasymmetrien berücksichtigt, oder die Transaktionskostentheorie nach Coase (1937), die Kosten der Benutzung von Märkten einbezieht. Die neuen institutionenökonomischen Theorien zeigen Situationen, in denen die Finanzierung von Unternehmen Auswirkungen auf deren Wert hat und auch der Marktwert einer Zahlungsmitteleinheit nicht mehr dem nominellen Wert entspricht. In der Folge hat die theoretische und empirische Forschung eine Vielzahl von Motiven und Determinanten identifiziert, die einzelne Gründe benennen, warum sich Unternehmen

für die Hortung von Zahlungsmitteln entscheiden und wie dieser Umstand mit dem Marktwert der betroffenen Unternehmen zusammenhängt.

Diese Arbeit besteht aus drei Beiträgen, die sich damit beschäftigen, warum Unternehmen einen bestimmten Bestand an Zahlungsmitteln halten und wie sich dieser Zahlungsmittelbestand auf den Wert der betroffenen Unternehmen auswirkt. Der erste Beitrag *A State-of-the-art Review of Corporate Cash Holding Research* stellt einen Übersichtsaufsatz dar, der den Stand der Cash Holding-Forschung diskutiert. Der Aufsatz systematisiert zunächst die heterogenen Theorien, die als Grundlage der empirischen Forschung dienen, und leitet auf dieser Basis theoretische Determinanten des Zahlungsmittelbestandes und seiner Marktwertwirkung ab. Im Anschluss werden die empirischen Verfahren zur Schätzung der theoretisch identifizierten Determinanten und ihres Zusammenhangs mit Cash Holdings sowie mit dem Marktwert der Cash Holdings kritisch vorgestellt. Auf dieser Grundlage wird nachfolgend der existierende empirische Befund zu den Auswirkungen der vorgestellten Determinanten auf den Zahlungsmittelbestand sowie zum Einfluss des Zahlungsmittelbestandes auf den Unternehmenswert diskutiert. Als Synthese dieses theoretischen, methodischen und empirischen Überblicks werden abschließend potentielle Wege für die zukünftige Forschung abgeleitet. Der Aufsatz wurde zur Veröffentlichung im *Journal of Business Economics* angenommen.

Der zweite Beitrag *Regional Differences in the Determinants of Cash Holdings* greift einen der im ersten Aufsatz identifizierten zukünftigen Forschungswege auf. Er untersucht, ob sich die Auswirkungen firmenspezifischer Eigenschaften auf den Zahlungsmittelbestand in Abhängigkeit von geographischen Regionen ändert. Die Untersuchung wurde im Jahr 2016 beim *Journal of Banking & Finance* eingereicht, und eine *Reject & Resubmit* Entscheidung ist ergangen. Der in dieser Dissertation enthaltene Artikel stellt die überarbeitete und wiedereingereichte Fassung dar. Weiterhin wurde die Untersuchung auf den Konferenzen *2016 Financial Management Association European* Conference, Helsinki; *European Accounting Association Annual Congress 2016,* Maastricht; *MAER-Net 2016 Colloquium*, Conway sowie *„Merton H. Miller" EFM Doctoral Seminar* im Rahmen des *European Financial Management Association 2016 Annual Meetings*, Basel (diskutiert durch Prof. *Ettore Croci,* Università Cattolica del Sacro Cuore; Prof. *Halit Gonenc,* University of Groningen; Prof. *Guanming He*, University of Warwick; Prof. *Gayané Hovakimian,* Ford-

ham University und Prof. *Anup Srivastava,* Tuck School of Business, Dartmouth College) sowie Doktorandenseminaren an der Universität zu Köln, der Universität Innsbruck und der Universität Neuchâtel vorgestellt.

Der dritte Beitrag *How to Induce Persistent, Value-Increasing, Cash Holding Policies: The Effect of Long-Term Incentives* folgt einem weiteren im Rahmen des ersten Aufsatzes aufgezeigten Forschungsweg. Die Studie untersucht, ob langfristig orientierte Managementvergütung ein geeignetes Instrument ist, um das Management dazu zu bewegen, langfristig ausgerichtete Strategien zur Steuerung des Zahlungsmittelbestandes zu verfolgen. Die Untersuchung wurde auf den Konferenzen *European Accounting Association Annual Congress 2017*, Valencia*; 14th Workshop on Corporate Governance 2017* des European Institute of Advanced Studies in Management, Brüssel und *53rd Annual Eastern Finance Association Meeting 2017*, Jacksonville (diskutiert durch Prof. *Yoon Choi*, University of Central Florida) sowie einem Doktorandenseminar an der Universität Innsbruck vorgestellt. Weiterhin wurde der Aufsatz im Rahmen des *14th Workshop on Corporate Governance 2017* auf die Liste der Best Papers aufgenommen.

2. A State-of-the-art Review of Corporate Cash Holding Research

2.1 Forschungsfrage

Die empirische Erforschung des Zahlungsmittelbestandes, den Unternehmen halten, sowie dessen Auswirkung auf den Marktwert von Unternehmen erfreut sich seit den grundlegenden Untersuchungen von Opler et al. (1999) sowie Harford (1999) großer Beliebtheit. Dieser Forschungstrend ist insbesondere durch die weltweite Beobachtung steigender Cash Holdings motiviert. Die Steigerung des Zahlungsmittelbestandes wurde sowohl von der Forschung als auch den Medien und teilweise der Politik wahrgenommen.[1] Folglich existiert eine Vielzahl von Perspektiven und Meinungen bezüglich der Ursachen und Wirkungen gehaltener Zahlungsmittel.

Vor diesem Hintergrund nimmt der erste Beitrag *A State-of-the-Art Review of Corporate Cash Holding Research* in Form eines Übersichtsaufsatzes eine Systematisierung und Würdigung der umfangreichen Cash Holding-Forschung vor. Beachtung finden Studien, die sich mit zwei zentralen Fragen beschäftigen: Was bestimmt den Zahlungsmittelbestand im Unternehmen? Wie wirkt sich dieser Zahlungsmittelbestand auf den Unternehmenswert aus? Der Aufsatz geht in drei Schritten vor. Zunächst werden die verschiedenartigen Theorien, auf denen die Cash Holding-Forschung aufbaut, strukturiert vorgestellt. Sie dienen als Grundlage, um die theoretischen Determinanten des Zahlungsmittelbestandes sowie seinen Effekt auf den Marktwert eines Unternehmens zu identifizieren. Im zweiten Schritt werden die gängigsten empirischen Methoden zur Untersuchung der Determinanten der Zahlungsmittelhaltung sowie ihrer Marktwertwirkung diskutiert. Ebenso werden die am häufigsten verwendeten empirischen Schätzmöglichkeiten der zuvor vorgestellten theoretischen Determinanten dargestellt. Im dritten Schritt wird der bisherige empirische Befund zum Einfluss der individuellen Determinanten auf die Cash Holdings sowie zum Marktwert von Cash Holdings aufgearbeitet. Dies ermöglicht schließlich die Ableitung zukünftiger Forschungsmöglichkeiten, die aus der existierenden Forschung resultieren.

[1] Vgl. Don Reisinger, "Apple's Cash Coffers to Swell to $250 Billon", Fortune, May 1, 2017; Tim Worstall, "If Microsoft has $92 Billion in Cash Then Why Has It Just Borrowed $10.75 Billion?", Forbes, February 10, 2015.

2.2 Ergebnisse und Forschungsbeitrag

Aus dem dreiteiligen Vorgehen des Aufsatzes resultieren drei zentrale Ergebnisse. Zunächst teilt sich das abgeleitete theoretische Rahmenwerk der Cash Holding-Forschung in zwei Kategorien auf. Dies sind zum einen Kapitalstrukturtheorien und zum anderen Theorien, die sich auf den Prinzipal-Agenten-Konflikt fokussieren. Diese beiden Kategorien umfassen verschiedene untergeordnete Theorien. Im Rahmen der Kapitalstrukturtheorien sind die Trade-off Theorie und die Pecking-order Theorie zu nennen. Die erste unterstellt, dass der Zahlungsmittelbestand aus einer Abwägung aller unmittelbaren Vor- und Nachteile der Haltung von Zahlungsmitteln resultiert und dass ein optimaler Zahlungsmittelbestand existiert. Die zweite Theorie besagt, dass die Finanzierung unternehmerischer Projekte einer strengen Hierarchie folgt. So werden Projekte zunächst durch interne Mittel finanziert. Fremdkapital wird aufgenommen, sobald die internen Mittel erschöpft sind. Die Aufnahme neuen Eigenkapitals kommt erst in Frage, wenn eine weitere Fremdkapitalaufnahme unmöglich ist. Die Eigenkapitalaufnahme stellt somit ein negatives Signal dar, da sie eine nicht vorteilhafte Projektbewertung durch Fremdkapitalgeber und eine potentielle Überbewertung der Eigenkapitalanteile impliziert. Dementsprechend hängt der Zahlungsmittelbestand von den zur Verfügung stehenden Möglichkeiten der Finanzierung und den zu finanzierenden Projekten ab.

Die Kategorie der Theorien, die sich auf den Prinzipal-Agenten-Konflikt konzentrieren, umfasst fünf untergeordnete Theorien. Die erste dieser Theorien ist die Flexibility-Hypothese gem. Jensen (1986). Sie besagt, dass Manager zukünftige finanzielle Flexibilität und Unabhängigkeit von externer Kontrolle anstreben und somit die Hortung von Zahlungsmitteln der sofortigen Investition dieses Zahlungsmittelbestandes vorziehen. Die zweite Theorie, die Spending-Hypothese oder Free-Cashflow-Hypothese von Jensen/Meckling (1976), betrachtet einen schwach kontrollierten Manager, der in der Folge dazu neigt, die vorhanden Zahlungsmittel schnell zu reinvestieren, dabei aber auch von Eigeninteresse getrieben ist und wertvernichtende Projekte initiiert. Die dritte Theorie stellt das Motiv der Verteidigung gegen feindliche Übernahmen nach Faleye (2004) dar und sieht die Hortung von Zahlungsmitteln als einen Verteidigungsmechanismus schwach kontrollierter Manager an. Die ineffiziente Unternehmensführung dieser Manager lockt feindliche Übernahmeangebote an. Die betroffenen Manager antizipieren solche Angebote und bauen einen Bestand an Zahlungsmitteln auf. Tritt ein feindlicher

Übernahmeversuch tatsächlich ein, können die gehaltenen Zahlungsmittel dazu verwendet werden Aktien zurückzukaufen, um so die angestrebte Übernahme zu verhindern. In der Shareholder Power-Hypothese, der vierten der untergeordneten Theorien, drücken Harford et al. (2008) aus, dass Anteilseigner unter bestimmten Umständen einen hohen Cashbestand befürworten. Dies sei der Fall, wenn die Aktionäre derart geschützt sind, dass sie einen Missbrauch des Zahlungsmittelbestandes nicht befürchten müssen. Folglich unterstützen sie die Vermeidung hoher Finanzierungskosten durch die Hortung interner Mittel. Als fünfte Theorie wird die Costly Contracting-Theorie nach Liu/Mauer (2011) betrachtet. Sie fokussiert sich auf junge und wachstumsstarke Unternehmen. Diese erhalten Fremdkapital oft nur unter der Auflage, bestimmte Vertragsklauseln (*debt covenants*) zu erfüllen. Diese Klauseln sehen häufig die Haltung eines bestimmten Mindestbestandes an Zahlungsmitteln vor, was Cash Holdings bei risikoreichen Unternehmen steigen lässt.

Auf Grundlage dieses Theorienüberblickes lassen sich verschiedene Determinanten ableiten, die den Zahlungsmittelbestand treiben, dies sind:

- die Unternehmensgröße,
- Investitions- und Wachstumsmöglichkeiten,
- die Verschuldung,
- die Profitabilität,
- schnell zu liquidierende Vermögenswerte, die Zahlungsmittel ersetzen können,
- Informationsasymmetrien,
- die Qualität der Corporate Governance,
- Finanzierungsprobleme bzw. Insolvenzgefahr,
- Investitionsaktivitäten und
- Dividenden.

Der erste Forschungsbeitrag dieser Arbeit liegt also zum einen in der systematischen Aufarbeitung der theoretischen Grundlagen der Cash Holding-Forschung. Zum anderen ermöglicht diese Aufarbeitung eine Unterscheidung der identifizierten Theorien hinsichtlich des von ihnen erwarteten theoretischen Einflusses der aufgeführten Determinanten auf die Cash Holdings bzw. deren Marktwertwirkung. Die Kapitalstrukturtheorien unterscheiden sich untereinander durch den erwarteten Zusammenhang der Un-

ternehmensprofitabilität sowie schnell liquidierbarer Vermögenswerte mit dem Zahlungsmittelbestand und seiner Marktwertwirkung. Die Theorien, die aus Überlegungen zum Prinzipal-Agenten-Konflikt resultieren, weisen größere Unterschiede auf. Insbesondere die Shareholder Power-Hypothese erwartet einen Zusammenhang zwischen den Determinanten und den Cash Holdings, der im Gegensatz zu den sonstigen Theorien dieser Kategorie steht.

Als zweiter Forschungsbeitrag ermöglicht die Aufarbeitung des empirischen Befundes zum Einfluss der theoretischen Determinanten die Überprüfung der zuvor abgeleiteten theoretischen Erwartungen und liefert Hinweise über die Relevanz der einzelnen Theorien. Die Mehrheit der betrachteten Studien berichtet, dass der Zahlungsmittelbestand steigt, wenn Wachstumsmöglichkeiten, Profitabilität und Finanzierungsschwierigkeiten bzw. die Insolvenzgefahr zunehmen. Hingegen sinkt der Zahlungsmittelbestand, wenn die Unternehmensgröße, die Verschuldung, der Umfang schnell zu liquidierender Vermögenswerte, Investitionsaktivitäten, Dividenden und die Qualität der Corporate Governance steigen. Die Auswirkung der Corporate Governance kehrt sich um, wie von der Shareholder Power-Hypothese erwartet, wenn Unternehmen sich in einem landesspezifischen Umfeld von schwachen Informationsasymmetrien oder hohem Investorenschutz befinden. Folglich steigt in einem solchen Umfeld der Zahlungsmittelbestand, wenn die Qualität der Corporate Governance steigt. Der Marktwert des Zahlungsmittelbestandes hängt hauptsächlich von zwei zentralen Determinanten ab: Der Qualität der Corporate Governance sowie Finanzierungsschwierigkeiten bzw. Insolvenzgefahr. Gehaltene Zahlungsmittel werden folglich als wertvoller erachtet, wenn die Qualität der Corporate Governance hoch ist oder ein Unternehmen Schwierigkeiten hat, sich extern zu finanzieren.

Den dritten Forschungsbeitrag bilden die Implikationen für zukünftige Untersuchungen, die sich aus dem Überblick existierender empirischer Ergebnisse gewinnen lassen. Zunächst fällt auf, dass die einzelnen Theorien zur Zahlungsmittelhaltung zwar umfassend untersucht wurden, jedoch ist wenig über ihr Zusammenwirken bekannt. Folglich erscheint es interessant zu untersuchen, in welchen Situationen einzelne Theorien an Bedeutung gewinnen und von welchen Determinanten die Bedeutung bzw. Abwägung der verschiedenen Theorien abhängt. Lebenszyklusmodelle stellen hierbei ein mögliches

Instrument dar, das es erlaubt, den Zahlungsmittelbestand und seine Determinanten über verschiedene unternehmerische Lebensphasen zu analysieren. Weiterhin fällt auf, dass bisher sowohl der Einfluss von Unternehmenseigenschaften als auch die Auswirkung von länder- bzw. regionenspezifischen Eigenschaften auf den Zahlungsmittelbestand und dessen Marktwertwirkung gesondert untersucht werden. Es ist allerdings unklar, ob sich diese beiden Arten von Determinanten in ihrem Effekt auf die Zahlungsmittel gegenseitig beeinflussen und folglich ein Interaktionseffekt vorliegt. Dies würde bedeuten, dass sich der Zusammenhang von Unternehmenseigenschaften und dem Zahlungsmittelbstand in Abhängigkeit von länderspezifischen Eigenschaften ändert. Eine solche Analyse würde ein genaueres Verständnis davon ermöglichen, wie länderspezifische oder regionale Charakteristika auf die Cash Holdings einwirken.

Die bisherige Forschung identifiziert neben der Qualität der Corporate Governance und Finanzierungsschwierigkeiten einen weiteren Treiber des Marktwerts der Zahlungsmittel: Die Persistenz von Cash Management Strategien. Mikkelson/Partch (2003), Martínez-Sola et al. (2013) und Oler/Picconi (2014) zeigen, dass der Marktwert von Zahlungsmitteln steigt, wenn er vorhersehbarer wird und das Management der Zahlungsmittel die Investoren nicht überrascht. In diesem Kontext stellt die Frage, wie ein derartiges vorhersehbares bzw. persistentes Zahlungsmittelmanagement erreicht werden kann, eine weitere Implikation für die zukünftige Forschung dar. Sobald Instrumente zur Anreizung solcher Strategien gefunden werden, stellt die Persistenz des Zahlungsmittelmanagements ein handhabbares Instrument zur Steigerung des Marktwertes der Zahlungsmittel dar. Schließlich zeigen Breuer et al. (2016), dass Wachstumsmöglichkeiten, gemessen durch Forschungs- und Entwicklungsaufwendungen (F&E), als Determinanten des Zahlungsmittelbestandes von Messproblemen betroffen sind. Es ist dabei unklar, ob F&E-Aufwendungen lediglich als Schätzer für Wachstumsmöglichkeiten dienen oder auch Informationsasymmetrien oder sogar das Ausmaß von Ambiguitätsaversionen schätzen. Letzteres bezeichnet die Scheu von Investoren vor unsicheren Investitionen.

3. Regional Differences in the Determinants of Cash Holdings

3.1 Forschungsfrage und Untersuchungsdesign

Der Aufsatz *Regional Differences in the Determinants of Cash Holdings* greift die Frage nach möglichen Interaktionseffekten zwischen unternehmens- und regionenspezifischen Determinanten des Zahlungsmittelbestandes auf, die im Rahmen des ersten Beitrags identifiziert wurde. Wie bereits erwähnt, untersucht die bisherige empirische Forschung die isolierten Effekte von Unternehmenseigenschaften sowie von regionalen bzw. Ländereigenschaften auf den Zahlungsmittelbestand und dessen Marktwertwirkung. Interaktionseffekte zwischen diesen beiden Kategorien von Determinanten werden nicht beachtet; dabei liefern sie potentiell Erklärungen dafür, wie Ländereigenschaften den Zahlungsmittelbestand beeinflussen können.

Denkt man beispielhaft an den Investorenschutz auf Landesebene, so dokumentiert die Forschung in erster Linie eine negative Assoziation dieser Determinante mit dem Zahlungsmittelbestand. Unternehmen halten also weniger Zahlungsmittel, wenn sie sich in einem Land befinden, das einen stark ausgeprägten Investorenschutz aufweist. Diese Beobachtung wird durch die Vernachlässigung von Interaktionseffekten allein auf einen direkten Zusammenhang des länderspezifischen Investorenschutzes mit den Cash Holdings zurückgeführt. Das würde bedeuten, dass Manager den Zahlungsmittelbestand allein deshalb nicht erhöhen, weil sie wissen, dass sie ihn nicht zu ihrem eigenen Vorteil und gleichzeitig zum Nachteil der Investoren verwenden können. Die Untersuchung von Interaktionseffekten könnte in diesem Beispiel ein differenziertes Verständnis der Wirkweise des landesspezifischen Investorenschutzes ermöglichen. Es könnte also analysiert werden, ob Unternehmen, die in Ländern mit starkem Investorenschutz operieren, tatsächlich unmittelbar ihren Bestand an Zahlungsmitteln senken, oder ob das Absinken des Zahlungsmittelbestandes nur die Konsequenz von anderen strategischen Entscheidungen ist, die vom landesspezifischen Investorenschutz motiviert werden. Es wäre also möglich die direkten Auswirkungen des Investorenschutzes als länderspezifische Determinante des Zahlungsmittelbestands vom interagierten Einfluss des landesspezifischen Investorenschutzes zu unterscheiden. Dieser Interaktionseffekt entsteht aus dem Zusammenwirken des landesspezifischen Investorenschutzes mit verschiedenen unternehmensspezifischen Eigenschaften.

Solche Interaktionseffekte sind für zahlreiche Kombinationen aus verschiedenen landes- und unternehmensspezifischen Determinanten des Zahlungsmittelbestandes denkbar. Beispielsweise könnten Unternehmen mit gut geschützten Investoren dazu neigen stärker in die Forschung und Entwicklung zu investieren; sie könnten die Aufnahme von Fremdkapital stärker gegenüber der Hortung von Zahlungsmitteln abzuwägen oder die gehorteten Zahlungsmittel häufiger auszuschütten. In diesen Fällen würde der Zahlungsmittelbestand sich nicht ausschließlich unmittelbar als Reaktion auf eine bestimmte Ausprägung des landesspezifischen Investorenschutzes verändern sondern ebenfalls, weil dieser Investorenschutz auf zahlreiche unternehmensindividuelle Entscheidungen einwirkt, die wiederum Einfluss auf den Zahlungsmittelbestand haben. Losgelöst von dem Beispiel des landesspezifischen Investorenschutzes ermöglicht die Betrachtung von Interaktionseffekten, zu verstehen, welche Unternehmensentscheidungen durch bestimmte Ländereigenschaften beeinflusst werden. Eines der Hauptziele dieses Aufsatzes ist es zu zeigen, dass zahlreiche Interaktionseffekte zwischen verschiedenen firmenspezifischen Determinanten und regionalen Eigenschaften vorliegen. Diese Erkenntnis soll die nachfolgende Forschung motivieren eine genauere Untersuchung einzelner Interaktionseffekte vorzunehmen.

Weiterhin untersucht der Aufsatz, ob Entscheidungen zur empirischen Ausgestaltung von Untersuchungen Auswirkungen auf deren Ergebnisse bezüglich der Determinanten der Cash Holdings haben. Konkret stellt sich die Frage, ob die Anwendung von Verfahren, die versuchen, einen kausalen Zusammenhang zwischen den Determinanten und dem Zahlungsmittelbestand zu etablieren, zu anderen Resultaten führen als Standard-OLS-Modelle. Zudem soll untersucht werden, ob die Definition der Cash Holding-Variablen, die Wichtigkeit einer Determinante für die jeweilige Untersuchung oder die Quelle der zugrundeliegenden Daten entscheidend für die abgeleiteten Resultate sind. Die Beantwortung dieser Fragen identifiziert Bereiche innerhalb der empirischen Modellierung, die besonders relevant sind für die jeweiligen Untersuchungsergebnisse und von Forschern mit besonderer Sorgfalt behandelt werden sollten.

Der Beitrag verfolgt demgemäß zwei Ziele: Zum einen ist zu untersuchen, ob es Interaktionseffekte zwischen verschiedenen unternehmensspezifischen und regionenspezifischen Determinanten des Zahlungsmittelbestandes gibt. Zum anderen sind die Einflüsse

empirischer Modellierungsentscheidungen auf die Ergebnisse der primären Forschung herauszustellen. Der Fokus der Studie liegt somit nicht auf der Ergründung eines einzelnen, bestenfalls kausalen, Interaktionseffekts. Vielmehr soll allgemein das Vorliegen zahlreicher Interaktionen zwischen unternehmens- und regionenspezifischen Determinanten des Zahlungsmittelbestandes aufgezeigt werden. Dieser Befund soll die Forschung motivieren individuelle Interaktionseffekte tiefer zu untersuchen und somit letztlich das Verständnis der Effekte regionaler Charakteristika zu verbessern. Dieses Forschungsziel setzt ein möglichst großes Sample an Unternehmensdaten, Untersuchungsjahren und erklärenden Determinanten voraus. Das zweite Forschungsziel, die Untersuchung der Wirkung von Modellierungsentscheidungen, legt die Verwendung bereits existierender Resultate, die möglichst heterogene Methoden verwenden, nahe. Aus der Kombination dieser Untersuchungsanforderungen lässt sich die Meta-Regressionsanalyse (*MRA*) gem. Stanley/Doucouliagos (2012), Stanley/Jarrell (1989) und Feld/Heckemeyer (2011) als geeignete Untersuchungsmethode identifizieren.

Die MRA ist vor allem ein Instrument, um existierende Forschung zusammenzufassen und zu analysieren. Das bedeutet, man erhebt den Zusammenhang zwischen einer erklärenden und einer abhängigen Variablen (*effect size*) aus einer Stichprobe existierender Untersuchungen. Ein solcher Zusammenhang ist beispielsweise vorgegeben durch den Regressionskoeffizienten oder t-Wert einer erklärenden Variablen. Eine MRA ist nun in der Lage festzustellen, welcher Zusammenhang in der Stichprobe von Untersuchungen insgesamt gefunden wird und inwiefern die individuellen Eigenschaften der zugrundeliegenden primären Untersuchungen diesen Zusammenhang beeinflussen. Diese Eigenschaften können viele denkbare Dimensionen der Primärstudien abdecken, zum Beispiel, ob börsennotierte oder private Unternehmen analysiert werden, das durchschnittliche Untersuchungsjahr oder das Alter der betrachteten Unternehmen. Weiterhin können auch die Auswirkungen der verwendeten ökonometrischen Methoden betrachtet werden. Die MRA erfüllt folglich alle Anforderungen, um die gesetzten Untersuchungsziele zu analysieren. Sie untersucht ein Sample aus zahlreichen existierenden Resultaten der vorausgegangenen Forschung, das etliche Regionen, Unternehmenstypen, und Jahre abdeckt sowie unter Verwendung verschiedener primärer Modelle erzeugt wurde. Somit lassen sich sowohl verschiedenste Interaktionseffekte zwischen zahlreichen unternehmensspezifischen Determinanten und regionalen Eigenschaften untersuchen als auch

der Einfluss der Ausgestaltung der primären empirischen Modelle auf die effect sizes der Primärforschung betrachten.

Zur Durchführung der Analyse wird eine Stichprobe aus den Ergebnissen von 45 Primärstudien erhoben. Dies führt zu insgesamt 3439 effect sizes, die als abhängige Variablen in der MRA dienen. Als effect size wird die Elastizität des Zahlungsmittelbestandes gegenüber einer bestimmten unternehmensspezifischen Eigenschaft verwendet. Sie besagt, um welche Prozentzahl sich die Hortung von Zahlungsmitteln ändert, wenn sich eine Unternehmenseigenschaft um 1% ändert. Diese Elastizität kann aus den Primärstudien berechnet werden, wenn eine Unternehmenseigenschaft als erklärende Variable des Zahlungsmittelbestands verwendet wird und somit ihr Regressionskoeffizient bekannt ist. Weiterhin muss der durchschnittliche Zahlungsmittelbestand sowie die durchschnittliche Ausprägung der betrachteten Unternehmenseigenschaft in der Primärstudie dokumentiert werden.

Insgesamt werden zehn verschiedene Elastizitäten untersucht. Diese Elastizitäten resultieren aus den zehn am häufigsten verwendeten unternehmensspezifischen empirischen Determinanten des Zahlungsmittelbestands: Die Unternehmensgröße definiert als Bilanzsumme, Investitionstätigkeiten definiert als Aufwendungen für Investition ins Anlagevermögen (*Capx*) zuzüglich Akquisitionsaufwendungen, Wachstumsmöglichkeiten geschätzt durch das Markt-/Buchwert-Verhältnis, F&E-Aufwendungen, die Verfügbarkeit schnell zu liquidierender Vermögenswerte gemessen durch das Net Working Capital, die Unternehmensverschuldung, die Unternehmensprofitabilität gemessen durch Cashflows, Dividenden, Finanzierungsschwierigkeiten bzw. Insolvenzgefahr und schließlich die Qualität der Corporate Governance. Somit müssen in jedem Untersuchungsschritt jeweils zehn Modelle geschätzt werden.

Das weitere Vorgehen des Beitrages ist in drei Schritte unterteilt. Erstens wird eine univariate MRA vorgenommen. Diese erklärt die zehn betrachteten Elastizitäten jeweils durch den Standardfehler des Regressionskoeffizienten, der für die Berechnung der betreffenden abhängigen Elastizität verwendet wurde. Dieses Vorgehen wird gem. Stanley/Doucouliagos (2014) auch als FAT-PET MRA bezeichnet. Es dient dazu, gegen die sogenannte Publikationsverzerrung zu kontrollieren. Die Publikationsverzerrung be-

sagt, dass Forscher einen Anreiz haben, entweder vornehmlich Ergebnisse zu dokumentieren, die ihren Erwartungen bzw. den Ansichten des jeweiligen Forschungszweiges entsprechen, oder ihre Modelle so lange zu modifizieren, bis die gewünschten Ergebnisse erzielt werden. Unter der Annahme, dass ein wahrer bzw. korrekter Wert für die Assoziation zwischen einer Determinanten und dem Zahlungsmittelbestand existiert, variieren alle Schätzungen dieses Zusammenhangs um die präziseste Schätzung. Je ungenauer eine Schätzung ist, desto stärker weicht sie von dem wahren Wert und seiner präzisesten Schätzung ab. Die Richtung der Abweichung sollte allerdings zufällig sein. Folglich soll die Gesamtheit der Beobachtungen gleichmäßig um die präziseste Schätzung verteilt sein. Die Präzision einer Schätzung kann über ihren Standardfehler beurteilt werden, somit sollte der Standardfehler als erklärende Variable im FAT-PET-Modell in keinen Zusammenhang mit der Elastizität als abhängige Variable stehen. Hingegen ist es ein Hinweis für Publikationsverzerrung, wenn der Standardfehler die abhängige Elastizität in eine bestimmte Richtung beeinflusst. Dies bedeutet, dass unpräzise Ergebnisse nicht gleichmäßig verteilt sind, sondern auf einen bestimmten Wert zulaufen. Konkret heißt dies, dass Forscher, die unpräzise Ergebnisse erzielen, dazu neigen, entweder nur solche Ergebnisse zu berichten, die ihren Erwartungen entsprechen, oder die zugrundliegenden Modelle bis zur Erzielung der gewünschten Ergebnisse zu verändern. Der Koeffizient des Standardfehlers im FAT-PET MRA stellt die Auswirkung der Publikationsverzerrung dar, den sogenannten FAT-Test, wohingegen die Konstante die Ausprägung der abhängigen Elastizität in Abwesenheit der Publikationsverzerrung darstellt, den sogenannten PET-Test. Die FAT-PET MRA wird im ersten Schritt dieses Beitrags verwendet, um für die vorliegende Stichprobe an primären Untersuchungen den Einfluss der Publikationsverzerrung auf jede der zehn Elastizitäten zu bestimmen (FAT-Test) und die durchschnittliche Ausprägung dieser Elastizitäten in Abwesenheit von Publikationsverzerrung abzuschätzen (PET-Test), die sogenannte *consensus association*.

Im zweiten Schritt wird eine multivariate MRA durchgeführt. Diese ergänzt die vorausgegangene univariate MRA um zahlreiche Variablen, welche die Eigenschaften der zugrundeliegenden Primärstudien modellieren. Von besonderer Bedeutung sind in diesem Kontext Dummy-Variablen für die geographischen Regionen, aus denen die beobachteten Elastizitäten stammen, sowie Dummies für die in den Primäruntersuchungen vorgenommenen empirischen Modellierungsentscheidungen. Konkret werden Dummy-

Variablen eingefügt, um Studien, die ausschließlich US-amerikanische Firmen betrachten, von rein europäischen Studien, rein asiatischen Studien sowie Studien mit international gemischten Stichproben zu unterscheiden. Als dritter Schritt wird die multivariate MRA um makroökonomische Eigenschaften der untersuchten Länder ergänzt. Dies wird unternommen, um die Ursachen der untersuchten Interaktionseffekte zu ergründen. Sämtliche Daten der empirischen Untersuchung wurden händisch aus der Stichprobe an Studien erhoben.

3.2 Ergebnisse und Forschungsbeitrag

Die beiden zentralen Beiträge des Aufsatzes bestehen zum einen darin aufzuzeigen, dass die Auswirkung der am häufigsten verwendeten unternehmensspezifischen Cash Holding-Determinanten in Abhängigkeit von der geographischen Region, in der sich ein Unternehmen befindet, variiert. Zum anderen identifiziert der Aufsatz die einflussreichsten empirischen Modellierungsentscheidungen. Dies bedeutet, dass aufgezeigt wird, welche Wahlmöglichkeiten im Rahmen der empirischen Ausgestaltung einer Untersuchung sich am stärksten auf die Ergebnisse der Untersuchung auswirken.

Im ersten Schritt der Untersuchung zeigen die univariaten MRA, dass der Zahlungsmittelbestand in der vorliegenden Stichprobe von Studien zunimmt, wenn das Markt-/Buchwertverhältnis, F&E-Aufwendungen, Finanzierungsschwierigkeiten bzw. die Insolvenzgefahr oder die Qualität der Corporate Governance zunehmen. Hingegen nehmen Cash Holdings ab, wenn die Bilanzsumme, Investitionsaktivitäten, das Net Working Capital, die Verschuldung, Cashflows oder Dividenden wachsen. Die Berücksichtigung der individuellen Eigenschaften der zugrundeliegenden Primärstudien im zweiten Schritt der Untersuchung zeigt, dass die zuvor identifizierten consensus associations zwischen geographischen Regionen variieren.

Studien zu US-amerikanischen und europäischen Firmen weisen ähnliche Einflüsse der betrachteten Unternehmenseigenschaften auf den Zahlungsmittelbestand auf. Studien zu asiatischen Firmen sowie Studien, die Stichproben mit Unternehmen aus verschiedenen Regionen analysieren, dokumentieren hingegen deutlich abweichende Zusammenhänge zwischen den unternehmensspezifischen Determinanten und der Zahlungsmittelhortung. Die regionalen Unterschiede beim Einfluss unternehmensspezifischer Cash

Holding-Determinanten können im dritten Schritt nicht gänzlich durch die makroökonomischen Eigenschaften einzelner Länder erklärt werden. Insbesondere die wirtschaftliche Entwicklung eines Landes, die Relevanz des nationalen Kapitalmarktes, der Demokratisierungsgrad eines Landes und der Grad internationaler Handelsverflechtungen sind nicht allein für das Vorliegen der regionalen Unterschiede verantwortlich. Die Tradition des nationalen Rechtssystems scheint hingegen ein bedeutenderes Erklärungspotential zu haben. Hier werden Länder, die zum römischen Rechtskreis (*civil law*) gehören, von solchen unterschieden, die zum anglo-amerikanischen Rechtskreis (*common law*) gehören. Dies deutet darauf hin, dass der Investorenschutz einer der zentralen treibenden Faktoren regionaler Interaktionseffekte ist, da dieser gem. La Porta et al. (2000) in common law countries deutlich ausgeprägter ist als in civil law countries. Jedoch ist die Messung der Rechtstradition recht ungenau, da die Stichprobengröße deutlich reduziert werden muss und folglich nur eine geringe Anzahl verschiedener Länder betrachtet werden kann.

Hinsichtlich des Zusammenhangs empirischer Modellierungsentscheidungen mit den primären Forschungsergebnisse kann gezeigt werden, dass Studien, die Instrumentalvariablen (Hansen/Singleton 1982) oder ein Difference-in-Differences-Modell (Card/Krueger 1994 und Feldstein 1995) verwenden, andere Ergebnisse erzielen als Studien, die lediglich OLS-Modelle einsetzen. Weiterhin führt auch die Verwendung von Fixed Effects, die Industrie- sowie Zeiteffekte kontrollieren, zu abweichenden Ergebnissen. Von diesen Entscheidungen sind vor allem die Bilanzsummen-, Net Working Capital-, Verschuldungs-, Dividenden-, Insolvenzgefahr- und die Corporate Governance-Elastizität des Zahlungsmittelbestandes betroffen. Die Wahl der Datenbank, auf deren Grundlage die Variablen einer Untersuchung bestimmt werden, sowie die Definition der Cash Holding Variablen haben keinen bzw. keinen klaren Einfluss auf die resultierenden Forschungsergebnisse.

Es lässt sich also festhalten, dass eine Vielzahl der unternehmensspezifischen Determinanten der Haltung von Zahlungsmitteln mit regionalen Eigenschaften interagieren. Dieser Befund hängt scheinbar weniger mit der Ausprägung der nationalen Kapitalmärkte und damit der Verfügbarkeit externer Finanzierungsmöglichkeiten, sondern mit dem nationalen Niveau des Investorenschutzes zusammen. Eine detailliertere Untersuchung

der Interaktionsweise individueller Ländereigenschaften mit einzelnen unternehmensspezifischen Treibern der Zahlungsmittelhortung soll in diesem Kontext nicht vorgenommen werden. Vielmehr motiviert der zweite Beitrag im Rahmen dieser Dissertation die zukünftige Forschung auf diesem Feld, indem er zeigt, dass vielfältige Interaktionseffekte vorhanden sind, die ein besseres Verständnis des Zusammenhangs von Ländereigenschaften und Zahlungsmittelbestand ermöglichen. Weiterhin zeigt der Aufsatz, dass die bisherige Cash Holding-Forschung möglicherweise von Endogenitätsproblemen befallen ist, da einfache OLS-Modelle zu anderen Ergebnissen führen als Instrumentalvariablen- oder Difference-in-Differences-Verfahren. Andere empirische Modellierungsentscheidungen treten diesem Befund gegenüber in den Hintergrund. Für künftige Untersuchungen kann es interessant sein, Methoden zu identifizieren, in denen eine kausale Interpretation des Einflusses der erklärenden Variablen auf den Zahlungsmittelbestand ermöglicht wird.

4. How to Induce Persistent, Value-Increasing, Cash Holding Policies: The Effect of Long-Term Incentives

4.1 Forschungsfrage und Untersuchungsdesign

Der Beitrag *How to Induce Persistent, Value-Increasing, Cash Holding Policies: The Effect of Long-Term Incentives* greift eine weitere der Forschungsmöglichkeiten auf, die im ersten Aufsatz diskutiert wurden. Er beschäftigt sich mit der Frage, wie ein Unternehmen bzw. das Management dazu motiviert werden kann, eine langfristige Strategie in Bezug auf die Zahlungsmittelhaltung zu verfolgen. Der Zahlungsmittelbestand wird laut Pinkowitz et al. (2006) und Faulkender/Wang (2006) vom Kapitalmarkt vorwiegend negativ wahrgenommen. Dementsprechend zeigen Dittmar/Mahrt-Smith (2007), dass 1$ zusätzliche Zahlungsmittel den Marktwert eines Unternehmens lediglich um 0,42$-0,88$ steigert. Jedoch existieren verschiedene Umstände, die den Marktwert der Zahlungsmittel erhöhen und sogar über einen Wert von 1$ steigern können.

Diese Umstände sind vor allem das Vorliegen von Finanzierungsschwierigkeiten bzw. Insolvenzgefahr sowie das Vorhandensein einer Corporate Governance von hoher Qualität. Entsprechend zeigen Kalcheva/Lins (2007) und Frésard/Salva (2010), dass der Marktwert des Zahlungsmittelbestands steigt und sogar einen Wert von 1$ überschreiten kann, wenn ein Unternehmen eine qualitativ hochwertige Corporate Governance

besitzt. Denis/Sibilkov (2010) dokumentieren eine Steigerung des Marktwertes gehaltener Zahlungsmittel, wenn Unternehmen finanziell eingeschränkt sind und Probleme bei der externen Finanzierung haben. Jedoch sind die beiden diskutierten Umstände, unter denen der Marktwert der Zahlungsmittel steigt, nicht geeignet, um diesen Marktwert aktiv zu steuern. Wie Larcker et al. (2007), Bhagat et al. (2008) und Brown et al. (2011) diskutieren, ist das Erreichen eines Systems hochwertiger Corporate Governance äußerst kompliziert, da einzelne Corporate Governance-Instrumente sich gegenseitig und teilweise gegenläufig beeinflussen. Weiterhin ist es unwahrscheinlich, dass Unternehmen sich freiwillig finanziellen Schwierigkeiten oder sogar einer gesteigerten Insolvenzgefahr aussetzen, um den Marktwert ihres Zahlungsmittelbestandes zu steigern.

Die Forschung identifziert jedoch einen weiteren Treiber des Marktwertes der Cash Holdings. So zeigen Mikkelson/Partch (2003), dass der Zahlungsmittelbestand die Profitabilität und den Marktwert von Unternehmen nicht beeinträchtigt und sogar steigern kann, wenn er konstant gehalten wird. Dieser Befund wird von Oler/Picconi (2014) und Chen/Shane (2014) konkretisiert. Beide dokumentieren, dass der Marktwert des Zahlungsmittelbestands bzw. seiner Veränderung sinkt, wenn dieser von Investoren nicht antizipiert werden kann. Eine solche mangelnde Antizipationsfähigkeit liegt vor, wenn der Zahlungsmittelbestand einer Periode nicht in der gleichen Weise von unternehmensspezifischen Determinanten bewirkt wird wie in den Vorperioden, folglich ein von der Vorperiode abweichendes Management des Zahlungsmittelbestands vorgenommen wird. Im Umkehrschluss bedeutet dies, dass ein persistentes und damit vorhersehbares Management der Cash Holdings deren Marktwert steigert. Die bisherige Forschung hat allerdings keinen Weg aufgezeigt, über den eine solche Art des Cash Holding-Managements bei Unternehmen motiviert werden kann.

Ein Instrument, das verwendet wird, um eine generelle Langzeitausrichtung des Managements zu erzielen, ist die langfristorientierte Vergütung über sogenannte *long-term incentives* (*LTIs*). Diese LTIs verknüpfen die Vergütung eines Managers mit der langfristigen Unternehmensleistung, um somit sein Interesse auf das langfristige Wohlergehen des Unternehmens zu lenken. Gopalan et al. (2014) und Li/Wang (2016) untersuchen die Determinanten von LTIs und zeigen, dass langfristorientierte Vergütung u. a. mit höheren Wachstumsmöglichkeiten, mehr langfristigen Vermögenswerten und einer ge-

steigerten Unternehmensprofitabilität assoziiert ist. Sie treffen jedoch keine Aussage über den Zusammenhang von Cash Holdings bzw. dem Management von Cash Holdings und LTIs. Weiterhin können sie auf Grund ihres speziellen Untersuchungsaufbaus keine kausalen Zusammenhänge herausstellen, da nur Fälle betrachtet werden, in denen eine freiwillige Einführung von LTI-Vergütung stattfindet und folglich die Gefahr der Selbstselektion und daraus resultierender Endogenität besteht.

Um derartige Probleme zu reduzieren und die Auswirkung langfristiger Vergütung auf den Zahlungsmittelbestand bzw. dessen strategische Steuerung zu untersuchen, betrachtet dieser Aufsatz den Einfluss des Gesetzes zur Angemessenheit der Vorstandsvergütung (*VorstAG*) auf die Persistenz des Managements der Zahlungsmittelhaltung. Das VorstAG bewirkte im Jahr 2009 die verpflichtende Einführung von LTIs bei allen deutschen börsennotierten Unternehmen. Auf dieser regulatorischen Grundlage lässt sich ein Difference-in-Differences-Modell im Sinne eines quasi-natürlichen Experimentes durchführen. Dies bedeutet, dass alle deutschen Unternehmen zunächst zwei Gruppen zugeordnet werden. Zum einen sind dies Firmen, die LTIs bereits freiwillig vor dem VorstAG verwenden (*EarlyLTI*), und solche Firmen, die LTIs gezwungenermaßen erstmalig mit dem VorstAG einführen (*Non-EarlyLTI*). Weiterhin lassen sich zwei Zeiträume unterscheiden: Die Periode vor dem VorstAG (2006-2008) sowie der Zeitraum seit der Einführung des Gesetzes (2009-2015). Im Rahmen der Untersuchung wird die Persistenz der strategischen Steuerung des Zahlungsmittelbestands für EarlyLTI- und Non-EarlyLTI-Unternehmen bestimmt. Nun wird die Differenz dieser Persistenzen im Zeitraum von 2006-2008 gebildet. Sie stellt den generellen Unterschied zwischen EarlyLTI- und Non-EarlyLTI-Unternehmen dar. Anschließend wird die Differenz der Persistenzen im Zeitraum von 2009-2015 gebildet. Sie spiegelt ebenfalls die Differenz zwischen EarlyLTI- und Non-EarlyLTI-Unternehmen wider sowie einen Zeittrend. Im letzten Schritt kann die Differenz der beiden vorab berechneten Differenzen gebildet werden. Sie drückt aus, inwiefern die Einführung des VorstAG den Unterschied zwischen EarlyLTI- und Non-EarlyLTI-Unternehmen verändert hat. Da beide Unternehmenstypen in Deutschland situiert sind, unterliegen sie abgesehen vom der Einwirkung der verpflichtenden langfristigen Vergütung den gleichen externen Einflüssen im Zeitverlauf. Weiterhin weisen die Unternehmen aus beiden Gruppen vergleichbare Eigenschaften

auf, da über ein Matching-Verfahren jedem EarlyLTI-Unternehmen ein möglichst ähnliches Non-EarlyLTI-Unternehmen gegenübergestellt wird.

Die Persistenz der strategischen Steuerung des Zahlungsmittelbestandes wird über das absolute Residuum aus einer Regression, die den Zahlungsmittelbestand erklärt, geschätzt. Das absolute Residuum stellt die absolute Abweichung zwischen dem prognostizierten und dem tatsächlichen Zahlungsmittelbestand einer Periode dar. Der Zahlungsmittelbestand wird auf Grundlage einer Regression, welche die klassischen unternehmensspezifischen Erklärungsvariablen gem. Opler et al. (1999) über 5 Jahre berücksichtigt, prognostiziert. Der Einfluss der unternehmensspezifischen Erklärungsvariablen kann dabei als strategischer Steuerungsansatz eines Unternehmens verstanden werden. Er beantwortet die Frage, wie ein Unternehmen auf bestimmte Unternehmenssituationen reagiert: In welchem Maß verändert sich der Zahlungsmittelbestand beispielweise, wenn die Unternehmensgröße, das Ausmaß der F&E Aufwendungen oder die Verschuldung steigt? Das absolute Residuum gibt folglich Aufschluss darüber, ob die unternehmensspezifischen Erklärungsvariablen auf den Zahlungsmittelbestand auf vorhersehbare Weise einwirken und somit der strategische Steuerungsansatz unverändert ist. Hohe bzw. steigende Werte des absoluten Residuums zeigen eine Veränderung im Cash Holding-Management und damit eine gesunkene Persistenz der strategischen Steuerung der Zahlungsmittelhaltung an.

LTIs sind ein zentrales Instrument, das laut Bebchuk/Fried (2004), Holmstrom (2005) und Bhagat/Romano (2009) dazu dient, die Interessen von Managern und Investoren zu vereinen und explizit eine Kurzfristorientierung der Unternehmensführung abzubauen. In Zusammenhang mit dem bereits dargestellten Befund, dass Investoren eine langfristige und vorhersehbare Strategie der Steuerung des Zahlungsmittelbestandes befürworten, wird auf dieser Grundlage folgende Hypohtese abgeleitet:

> H: Strategien der Steuerung der Zahlungsmittelhaltung werden persistenter, also weniger variabel, wenn die Vergütung des Managements von der langfristigen Unternehmensleistung abhängt.

Folglich wird erwartet, dass im Zeitraum von 2006-2008 die EarlyLTI-Unternehmen im Vergleich zu ihrer Non-EarlyLTI-Vergleichsgruppe eine persistentere Strategie in der Steuerung des Zahlungsmittelbestandes verfolgen. Dieser Unterschied sinkt im Zeitraum von 2009-2015, da Non-EarlyLTI-Unternehmen auf Grund der Einführung des VorstAG ebenfalls persistentere Strategien des Cash Holding-Managements verwenden. EarlyLTI- und Non-EarlyLTI-Unternehmen wurden auf Grundlage der händischen Erhebung von Vergütungsinformationen im Rahmen der Vergütungsstudie Managergehälter 2010-2016 bestimmt. Sonstige Rechnungslegungs- und Kapitalmarktinformationen wurden der Datenbank Compustat Capital IQ Global entnommen.

4.2 Ergebnisse und Forschungsbeitrag

Die Ergebnisse der Untersuchung bestätigen die aufgestellte Hypothese und zeigen, dass durch die verpflichtende Einführung einer langfristigen Vergütung das Cash Holding-Management der betroffenen Unternehmen eine stärkere Langfristorientierung und somit eine höhere Persistenz aufweist. Diese Beobachtung wird vor allem durch Unternehmen mit einem hohen Bestand an Zahlungsmitteln getrieben. Diese Untergruppe der Unternehmen neigt nach der Einführung des VorstAG besonders zu einer langfristigeren Steuerung der Zahlungsmittelhaltung. Weiterhin zeigen zahlreiche Abwandlungen des grundlegenden Difference-in-Differences-Modells die Robustheit der Ergebnisse. Reduzierte Modellvarianten, die Multikollinearität vermeiden sollen, bestätigen die Ausgangsergebnisse. Die Untersuchung mit einem sogenannten Placebo-Ereignis, das zu einem anderen Zeitpunkt als das VorstAG stattfindet, generiert erwartungsgemäß keine Resultate. Dies deutet darauf hin, dass die beobachteten Resultate tatsächlich durch das VorstAG herbeigeführt werden. Die verschiedenen Annahmen des Matching-Vorgangs werden ebenfalls schrittweise abgewandelt. Dies dokumentiert die hohe Robustheit der Ergebnisse gegenüber der Spezifikation des Matchings von EarlyLTI- und Non-EarlyLTI-Unternehmen.

Eine ergänzende Analyse des Marktwertes des Zahlungsmittelbestandes bestätigt die Ausgangsannahme, dass Cash Holdings vom Kapitalmarkt als wertmindernd angesehen werden. In diesem Kontext kann gezeigt werden, dass die Variabilität des Managements des Zahlungsmittelbestandes den Marktwert der Cash Holdings senkt. Im Umkehrschluss bedeutet dies, dass eine persistentere strategische Steuerung der Zahlungsmit-

telhortung den Marktwert der Cash Holdings steigert. Eine zusätzliche Betrachtung verschiedener Variabilitätsgrade des Cash Holding-Managements zeigt, dass grundsätzlich eine höhere Persistenz mit einer größeren Wertschätzung des Zahlungsmittelbestandes am Kapitalmarkt einhergeht. Dennoch existieren Situationen, in denen die Steuerung der Zahlungsmittelhaltung zu persistent, folglich zu wenig variabel sein kann und ebenfalls den Marktwert der Cash Holdings senkt. Dieser Effekt betrifft aber nur eine kleine Teilgruppe der untersuchten Unternehmen, weswegen die gesteigerte Persistenz insgesamt den Marktwert der Zahlungsmittelhortung erhöht.

Die erläuterten Ergebnisse liefern verschiedene Erkenntnisse für die Forschung zur Haltung von Zahlungsmitteln sowie auch für die Forschung zur Wirkung langfristiger Vergütung. Erstens identifiziert der Beitrag langfristige Managementvergütung als ein geeignetes Instrument, um Manager dazu zu bewegen, die Steuerung des Zahlungsmittelbestandes langfristig auszurichten. Folglich stellt vor diesem Hintergrund das langfristige und aus Investorensicht vorhersehbare Management des Zahlungsmittelbestands ein handhabbares Instrument zur aktiven Beeinflussung des Marktwertes des Zahlungsmittelbestandes dar. Zweitens repräsentiert dieses Ergebnis einen realen Effekt des VorstAG und liefert somit Erkenntnisse über die Wirkung der Regulierung. Dies ist nicht nur für einen deutschen oder europäischen Regulierer von Interesse, sondern auch im nordamerikanischen Raum von Bedeutung. Die Securities Exchange Comission (*SEC*) und andere US-Behörden haben im Jahr 2016 eine Erweiterung des Dodd-Frank Act vorgeschlagen. Diese enthält Regelungen zur variablen Vorstandsvergütung, die in ihrer Konsequenz dem VorstAG nahekommen. Sie haben eine Fokussierung auf die langfristige Managementvergütung zur Folge.

Drittens stellen die Ergebnisse einen Beitrag zur Forschung bezüglich der Wirkung langfristiger Managementvergütung dar. Der beobachtete Effekt stellt somit sowohl eine reale Wirkung des VorstAG als auch eine bisher nicht dokumentierte reale Wirkung langfristiger Vergütungsanreize dar. Die besondere Bedeutung dieses Effekts der LTIs im Rahmen dieser Untersuchung besteht darin, dass die klassischen Endogenitätsprobleme dieses Forschungszweigs reduziert werden können. Normalerweise wird in diesem Kontext stets die freiwillige Einführung von LTIs untersucht. Derartige Situationen sind geprägt von mangelnder Vergleichbarkeit, da unklar ist, ob die Unternehmen, die freiwillig

langfristige Vergütungsanreize einführen, sich nicht ex-ante von anderen Unternehmen unterscheiden. Die Gefahr einer solchen Selbstselektion wird durch die regulatorische Situation rund um das VorstAG in Deutschland reduziert, weshalb das gefundene Ergebnis einen höheren kausalen Aussagegehalt besitzt. Schließlich stellt die Identifikation des VorstAG als Gelegenheit der Forschung zur LTI-Wirkung einen methodischen Beitrag dar. Die nachfolgende Forschung kann diese Gesetzeseinführung verwenden, um weitere Erkenntnisse über die Wirkung langfristiger Vergütungsanreize zu sammeln und gleichzeitig den Einfluss von Endogenitätsproblemen zu reduzieren.

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Teil 2

A State-of-the-Art Review of Corporate Cash Holding Research

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A State-of-the-art Review of Corporate Cash Holding Research

Jan Felix Weidemann[1]

Abstract

This study contributes to a better understanding of the determinants of corporate cash holdings and their effects on firm value. First, the extensive theoretical basis of corporate cash policies is disentangled. I distinguish two categories of theories. The first category comprises theories that stem from capital structure research, namely, the trade-off theory and the pecking-order theory. The second category includes theories that focus on agency conflicts. Second, this review identifies the most common proxies used in empirical research, aggregates them into general categories of determinants, and compares their predicted influences, according to different theories. In sum, 10 general determinants, including firm size, growth opportunities, leverage, liquidity substitutes and corporate governance, are found to influence corporate cash holdings. Third, this article reviews the empirical evidence regarding what determines the level and market value of cash holdings, compares these observed associations to the predicted theoretical associations, and identifies avenues for future research.

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Keywords: corporate cash holdings, pecking-order theory, trade-off theory, agency theory, corporate governance, state-of-the art, review

JEL classification: G31, G32, G3

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1 Introduction

Although a common proverb suggests that "Cash is King", corporate cash holdings are highly polarizing and trigger vivid public discussion. The most prominent examples are perhaps Apple and Microsoft, whose cash hoarding behavior frequently makes headlines.[1] An increased tendency to hold cash has also been recognized in the scientific research. Opler et al. (1999), Foley et al. (2007), and Bates et al. (2009) document a growing tendency among US firms to hoard cash, and Pinkowitz et al. (2012) document this trend among international firms. For example, Bates et al. (2009) find an increase in the average corporate cash ratio of 12.7% from 1980 to 2006.

Empirical investigation of cash holdings was initially encouraged by the work of Harford (1999) and Opler et al. (1999), which motivated a series of follow-up studies (e.g., Dittmar et al. (2003), Faulkender/Wang (2006), D'Mello et al. (2008), Frésard (2010), Khieu/Pyles (2012), Harford et al. (2014), and Chen et al. (2015)). This branch of research focuses on two interdependent research questions: What determines a company's cash holding policy? What influence does this cash holding policy have on a firm's value, i.e., what is the market value of cash?[2]

This review addresses these questions in three ways. First, it presents a theoretical framework in which research on cash holding can be understood. Second, it identifies the most common determinants of the level and market value of cash, using the theoretical framework set out, and compares the predicted effects of these determinants, according to different theories. Third, the review provides a discussion of the empirical results of cash holding research. This includes depicting the models used, reporting the observed influence of the common determinants, comparing these observations with theoretical predictions, and deriving implications for future research.

Existing empirical studies are driven by a diverse set of theories that constitute the foundation of cash holding research. For example, Opler et al. (1999) investigate the ability of common capital structure theories to explain the level of cash. They find support for both the trade-off theory and the pecking-order theory, whereas Harford (1999) provides evidence that increasing cash reserves is associated with agency problems. More recent examples, such as Harford et al. (2008), Chen et al. (2012), and Harford et al. (2014), focus further on the agency perspective. Furthermore, Bates et al. (2009), Duchin (2010), and Hoberg et al. (2014) note the importance of constrained liquidity and the avoidance of underinvestment. I identify two general categories of theories employed in cash holding research. First, there are the capital structure theories, namely, the trade-off theory, as predicted by the models of Modigliani/Miller (1963), Bradley et al. (1984), and Titman/Wessels (1988), and the pecking-order theory of Myers/Majluf (1984). According to the trade-off theory, the level of cash results from comparing the costs and benefits of holding cash, while the pecking-order theory proposes that the cash stock is driven by ex-ante information asymmetries that make external financing costly. Second, there is a branch of theories that focus on agency conflicts resulting from information asymmetries between managers and investors, with the cash stock determined by these conflicts. This category comprises five theories. First, there is the flexibility hypothesis (Jensen (1986)), which states that managers prefer future financial flexibility and seek to avoid external discipline over current investment. Second, there is the spending hypothesis (Jensen/Meckling (1976)), according to which weakly controlled managers overinvest. Third, there is the motive of defense against hostile takeovers (Faleye (2004)), whereby cash is seen as an instrument to fight hostile takeovers that are attracted by bad corporate governance. Fourth, there is the shareholder power hypothesis (Harford et al. (2008)), which observes that shareholders appreciate large cash holdings when they are sufficiently protected. Fifth, there is the costly contracting theory (Liu/Mauer (2011)), which proposes that risky firms hold more cash because debt covenants enforce a higher cash stock.

These underlying theories identify the determinants of the cash level and its market value. I discuss the 10 determinants most commonly featured in the research, namely, firm size, investment

[1] See, for instance, Tim Worstall, "If Microsoft has $92 Billion in Cash Then Why Has It Just Borrowed $10.75 Billion?", Forbes, February 10, 2015; Rana Foroohar, "What Apple's Gargantuan Cash Giveaway Really Means, Time, April 27, 2015; and Julie Bort, "Microsoft Has Nearly $93 Billion In Overseas Cash, And It's Reduced Its Tax Bill By Almost $30 Billion", Business Insider, August 23, 2014.

[2] In cash holding research, the term "market value of cash" is used to describe the contribution of corporate cash to firm value. Theories of cash hoarding provide reasons why one incremental dollar held in cash does not equal an increase in firm value of 1 dollar.

and growth opportunities, leverage, profitability, liquidity substitutes,[3] information asymmetries, corporate governance, financial distress, investment activities, and dividends. The capital structure theories derive nearly identical predictions regarding the effects of the determinants of the level and market value of cash. They differ with regard to the effects of profitability and liquidity substitutes. Agency-based theories are more distinct from one another. The shareholder power hypothesis predicts a pattern of associations between the determinants and the level of cash that is contrary to all other agency-based theories. The remaining theories in this category differ in terms of the assumed influence of profitability and liquidity substitution on the cash level.

These diverse theoretical foundations lead to equally numerous and versatile empirical studies. The focus of such studies varies and embraces, among other things, the influence of family companies (Liu et al. (2015)), CEO compensation (Liu/Mauer (2011) and Liu et al. (2014)), product market competition (Qiu/Wan (2015)), accounting quality (Biddle et al. (2009)), and cross-listings obtained in the US (Frésard/Salva (2010) and Huang et al. (2013)). The majority of studies report that the level of cash increases when growth opportunities, profitability, or liquidity constraints increase. The cash level is found to decrease when firm size, leverage, liquidity substitutes, investment activities, or dividends increase. The shareholder power hypothesis applies only when corporate governance is of high quality, and the respective firm operates in a country with strong shareholder protection. When country-level shareholder protection is moderate, predictions of the flexibility and spending hypotheses gain importance, which implies that high quality corporate governance is associated with decreasing cash holdings. Weak corporate governance and high information asymmetries are associated with cash being spent faster on inefficient acquisitions as well as capital expenditures, and liquidity substitutes being turned into cash more often. The value of cash depends on two key drivers, namely, information asymmetries and liquidity constraints. The former lowers the market perception of cash, while the latter improves it. Furthermore, a persistent policy of high cash holdings is reported to positively influence a firm's market position and performance compared with low-cash competitors. This highlights the varying importance of different cash holdings theories. Trade-off theory appears to explain corporate cash policies when no individual problem dominates corporate decisions. Pecking-order theory is prevalent in times of constrained liquidity, and agency-based theories gain importance with increasing information asymmetries.

Reviewing the empirical evidence suggests directions for future research. First, the interplay between cash holding theories is not well understood. The importance of these theories changes according to a firm's environment and characteristics. Life-cycle models offer a potential way to understand the link between different theories and their changing relevance. Such models investigate how the level of cash and the determinants of the cash stock change over a firm's life, i.e., at different stages of the life cycle. Each stage of a firm's life cycle features different firm and environmental characteristics. This may offer a way to analyze changes in the importance of underlying theories as well as links between these theories over different stages of a firm's life. Second, country- and industry-level characteristics, such as shareholder protection, affect the association between firm-level characteristics and cash holdings. Current research focusses either on country- or firm-level characteristics, ignoring their interactions. Investigating such interaction effects may aid understanding of how specific country-level characteristics affect the level of cash. This would mean, for example, not only investigating whether firms hold more cash in an environment of strong investor protection but also studying how the association between firm characteristics and the level of cash changes when investor protection is strong. Third, the persistence of cash has been shown to increase the market value of cash holdings. Thus, analysis of the determinants of cash holding persistence should be pursued in future research, as it offers an opportunity to identify instruments that induce value-increasing cash policies. Another task is to separate the effect of ambiguity aversion from the association between R&D expenditures or, alternatively, information asymmetries and the level and the value of cash holdings. The remainder of this paper is structured as follows: Section 2 discusses the theoretical basis of cash holding research. Section 3 reviews the empirical cash holding research. I conclude in section 4.

[3] The term "liquidity substitutes" sums up factors that make the hoarding of cash unnecessary. This is, for example, the case when a firm can finance investments directly from operating cash flow or has assets that are easy to liquidate.

2 Theories of cash holdings

Several theories constitute the foundation of empirical research on corporate cash holdings and identify the determinants of the level and market value of cash. These theories can be structured into two general strands: capital structure theories and theories that focus on agency conflicts. A reference point for all these underlying theoretical viewpoints is the irrelevance of the capital structure according to Modigliani/Miller (1958), which states that in perfect capital markets, a firm's value is independent of its sources of financing. Both categories of theories used in cash holding research relax the assumption of perfect capital markets.

2.1 Capital structure theories

Capital structure theories consider a firm's entire financing decision rather than its cash holding policy exclusively. Such theories also embrace agency problems. However, the trade-off theory considers numerous other factors besides agency issues, and the pecking-order theory considers agency problems that differ from those discussed in the second category of theories.

2.1.1 Trade-off theory

The trade-off theory emerged out of the original Modigliani/Miller (1958) paper when taxes were taken into consideration by Modigliani/Miller (1963). Its main features are a trade-off between the tax-deductibility of debt and bankruptcy costs[4] and the notion of an optimal capital structure. When converting the trade-off theory from explaining the capital structure to explaining the corporate cash balance, the costs and benefits of holding cash are considered. Cash holdings are assumed to stem from operating cash flows and not from debt issuance. The benefits of holding cash consist of saving on transaction costs that occur with external financing, as proposed in Keynes' (1936) transaction cost motive, and avoiding underinvestment. Thus, a firm's access to capital markets, which can be determined by firm size, profitability, and a firm's probability of facing financial distress, is a determinant of cash holdings. Additional determinants are the availability of liquidity substitutes and a firm's investment in fixed and intangible assets.

The costs of holding cash include various elements: A firm unable to invest cash misses returns and the tax benefits of debt financing. Furthermore, cash can potentially be used discretionarily by managers, which leads to agency costs. In sum, a firm's leverage, taxes, the quality of its governance, and the degree of information asymmetry determine the level and value of its cash holdings. The outcome of this trade-off is an optimal level of cash that depends on the costs and benefits of cash hoarding.

2.1.2 Pecking-order theory

The pecking-order theory focuses on hidden characteristics in the spirit of Akerlof's (1970) market for lemons and is thus based on agency conflict. I do not include this theory in section 2.2 because the pecking-order theory is seen as a major stand-alone theory of the firm's capital structure. Moreover, the theories in section 2.2 focus on hidden actions and hidden information instead of hidden characteristics.

The theory analyzes a situation in which managers and potential investors have asymmetric information regarding a company's value. The company must raise funds to finance a project. However, there is an incentive to avoid projects that have positive net present value (NPV) if the company is currently undervalued. This is the case when the NPV that can be earned from a project is smaller than the undervaluation, i.e., when the loss from issuing undervalued equity is not offset by the project's profit. If the company's value is overstated, the firm's managers will always issue equity because they know they will earn more than the firm is worth. Thus, issuing equity securities to finance a project is a bad signal for investors, who will either avoid securities or demand a risk premium. The result of these considerations is a financing hierarchy. A positive NPV project will be financed by internal funds, i.e., hoarded cash, to avoid the problem of underinvestment as well as agency costs associated with debt and equity. If further external funds are needed, the firm prefers debt over equity because of the negative signaling effect of equity. Debt provides a positive signal because

[4] These bankruptcy costs not only include costs that occur as a result of bankruptcy but also costs of increased leverage. Such costs arise, for example, because of a change in credit ratings or increased agency conflicts between debt and equity holders, as suggested by Myers (1977 and 2003).

it shows that a firm is willing to undertake an obligation to make fixed interest payments. Consequently, the pecking-order theory identifies the same factors in determining the level and value of cash holdings as the trade-off theory. However, it puts more emphasis on the role of information asymmetries and growth/investment opportunities.

2.2 Agency conflicts

The second major category comprises theories that explain corporate cash holdings from an agency viewpoint. These agency-based theories consider the threat of having a non-owner manager use a firm's cash for her own utility maximization instead of serving the owner. This risk is mainly driven by hidden actions and hidden information, which means that the principal cannot control or monitor how the agent spends the company's money.

2.2.1 Flexibility hypothesis

The flexibility hypothesis assumes that managers prefer future financial flexibility over current investment (Jensen (1986)). Thus, cash is held to finance future projects and avoid external discipline from the capital market. The hypothesis implies that weakly controlled and risk-averse managers are expected to hold higher cash reserves. Moreover, cash holdings are expected to be positively evaluated by the capital market because they are an instrument to avoid a shortage of available funds. The is of hoarding cash to guard against unexpected events is also framed in the precautionary motive by Keynes (1936), which does not focus on agency-conflicts.

A motive closely related to the flexibility hypothesis is the motive of constrained liquidity. This motive is also mainly driven by the objective of avoiding a shortage of funds that leads to the omission of profitable projects. However, the motive of constrained liquidity focuses on one specific reason for a potential deficit in available funds instead of on the abstract risk of underinvestment. Such constraints may arise from the volatility of cash flows (see Opler et al. (1999), Han/Qiu (2007), and Chen et al. (2014)), credit ratings (Graham/Harvey (2001), Brisker et al. (2013), and Harford et al. (2014)), and relationships with banks (Steijvers/Niskanen (2013)). Predictions derived from specific liquidity constraints are similar to predictions derived from the flexibility hypothesis. A firm is expected to address the risk of illiquidity by building up cash. This means that a firm with highly volatile cash flows, bad or no credit ratings, limited relationships with banks, or other liquidity constraints is expected to hoard cash to mitigate the high costs of external financing and ultimately avoid underinvestment.[5] The market value of cash holdings increases in these firms because the cash stock prevents the operating business from being affected by liquidity constraints.

Finally, Acharya et al. (2007) introduce another motive that is similar to the flexibility hypothesis: the hedging perspective. This motive stresses the difference between holding cash and paying off debt for constrained firms. Hoarding cash is preferred to reducing debt when cash flows and investment opportunities exhibit a low correlation. Consequently, cash holdings play a valuable role in hedging against future deficiencies in funds when a firm's cash flows are not expected to rise with future investments. This means that cash holdings serve as an instrument to maintain a certain level of investment over time. The intent to hedge with cash holdings increases when managers are risk-averse and information asymmetries are high. When cash flows and future investments are highly positively correlated, paying off debt is preferred to holding cash. In such cases, cash hoarding is not needed because future operating cash flows will be sufficient to fund investment opportunities. Thus, according to the hedging perspective, cash flows, growth opportunities, and the correlation between them influence the level and market value of cash. In summary, the flexibility hypothesis identifies the quality of corporate governance, information asymmetries, liquidity constraints, liquidity substitutes, and growth/investment opportunities as drivers of the level and market value of cash holdings.

2.2.2 Spending hypothesis

The spending hypothesis focuses on managers who, contrary to the flexibility hypothesis, prefer current investments over future financial flexibility. These managers tend to overinvest when they are weakly controlled and have cash available (Jensen/Meckling (1976)). This is problematic when there are no more profitable investments, and managers spend cash on value-destroying projects instead of paying it out to shareholders. There are several reasons for such behavior, as listed by Myers (2003):

[5] Ozkan/Ozkan (2004) provide an overview of common liquidity constraints and their effects.

seeking monetary benefits or certain firm assets, career concerns, and additional non-monetary reasons such as reputational effects and management hubris. Thus, the spending hypothesis distinguishes current investments in fixed and intangible assets from future growth/investment opportunities as determinants of the level and value of cash holdings.

2.2.3 Shareholder power hypothesis

The shareholder power hypothesis (Harford et al. (2008) and Kuan et al. (2011)) proposes a situation in which minority shareholders support cash stockpiling to avoid the underinvestment problem because they are sufficiently protected from expropriation, and interests are aligned. This change in the perception of cash holdings is also referred to as the alignment hypothesis (Liu/Mauer (2011)). These theories predict an increase in cash holdings due to an alignment of interests and decreasing agency problems.[6] Thus, the quality of corporate governance is the central influencing factor in cash holdings.

2.2.4 Costly contracting theory

The costly contracting theory of Liu/Mauer (2011) models a reaction to the riskiness of growth firms. The theory proposes that creditors anticipate risky investment behavior by young firms and demand incremental covenants that force the debtor to hold cash. The costly contracting theory derives predictions similar to those of the pecking-order theory. Firms are expected to prefer internal over external financing when the costs associated with the latter increase. Thus, the costly contracting hypothesis identifies the same factors to drive the level and value of cash as the pecking-order theory. However, the theories can be distinguished by the market valuation of cash. Investors attribute more value to cash held by firms that act in accordance with the pecking-order theory, as such firms can avoid the costs of external financing and pursue their investment projects without restraint. If the costly contracting theory applies, the value of cash is expected to decrease because creditors are likely to extract benefits from their debtors and limit risk-taking by firms. This means that cash reserves cannot be spent on investments, and thus, the freedom of investment is constrained.

2.2.5 Defense against hostile takeovers

The takeover defense motive can be regarded as a consequence of the flexibility and spending hypotheses. Faleye (2004) observes that high cash balances are associated with managerial discretion. This discretion might manifest itself in the form of excessive precautionary cash holdings or overinvestment. Such discretionary actions decrease shareholder value and attract hostile takeover attempts. Managers recognize this takeover threat and react by hoarding cash to ease the application of anti-takeover measures. Thus, cash holdings simultaneously increase the likelihood of becoming a target of a hostile takeover and the likelihood of successfully fighting off such an attempted takeover. This explains why high cash levels do not appear to be associated with an increased number of takeover attempts (Harford (1999)). The disciplining effect of the market, in the form of hostile takeovers, does not become effective. Thus, the takeover defense motive models managerial actions that aim to bypass external discipline. Similarly, to the shareholder power hypothesis, the defense against hostile takeovers motive focuses on the quality of corporate governance in determining the level and value of cash holdings.

2.3 Theoretical determinants and the value of cash

The theories introduced in section 2.1 and 2.2 identify several factors that determine the level and market value of cash holdings: firm size, growth/investment opportunities, leverage, profitability, liquidity substitution, information asymmetries, the quality of corporate governance, the probability of financial distress, investment activity, and dividends. These determinants are employed in the most frequently used empirical models in the cash holding research.[7] Table 1 summarizes how different

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[6] The alignment hypothesis states that such a convergence of interests can be achieved through equity-based compensation of managers (Liu/Mauer (2011)) and other instruments of corporate governance (Chen/Chuang (2009)). The shareholder power hypothesis considers shareholder protection more broadly, including protective legal regulation.

[7] See section 3.1.

cash holding theories predict these determinants will influence the level of cash holdings (Panel A) and their market valuations (Panel B).

Panel A documents the influence of individual determinants on the level of cash maintained by a firm. Within the first category of theories, the effect of liquidity substitution distinguishes the trade-off theory and the pecking-order theory. If cash substitutes that do not cause transaction costs to exceed the costs of hoarding cash are available, there is no reason to maintain a high cash level, according to the trade-off theory. In contrast, the pecking-order theory predicts these substitutes will be turned into cash to avoid underinvestment. Furthermore, the trade-off theory does not provide a clear prediction of the influence of profitability on the cash stock. A firm is believed to obtain easier access to the capital market when its profitability grows, and thus, the need to hoard cash declines. Increased profitability may also lead to additional agency problems caused by a lack of external control, induced by management success. These agency problems are associated with an increase in cash to avoid future external control by the capital market.

[Insert table 1 about here]

Within the second category of theories, the shareholder power hypothesis can be separated from all other theories. The theory predicts that cash holdings will increase when external control increases because shareholders then feel protected from expropriation and allow for cash holdings. The remaining agency-based explanations presume that cash is not viewed positively by shareholders and is only hoarded when managers can act with discretion. Consequently, the level of cash is expected to decrease when external control increases. These remaining agency-based theories are difficult to differentiate. Profitability and liquidity substitution offer some insights. Increased profitability as well as an increase in liquidity substitutes decrease the risk of underinvestment and therefore decrease the need to hoard cash, based on the precautionary motive assumed by the flexibility hypothesis. The costly contracting theory is consistent with this prediction, as increased profitability and more liquidity substitutes ease access to debt and soften debt covenants. The spending hypothesis takes a different standpoint. It predicts that management will use incremental cash that is available due to increased profitability or an increase in liquidity substitutes for inefficient investments.

Both general categories of theories make largely overlapping predictions regarding the association between individual determinants and the level of cash. The flexibility hypothesis and the costly contracting theory confirm the predictions of the trade-off theory by assuming a negative association between the cash level and both profitability and liquidity substitutes. The spending hypothesis and the hostile takeover defense motive overlap with the pecking-order theory in assuming a positive association between the level of cash and both profitability and liquidity substitutes. The shareholder power hypothesis is the only theory that exhibits a clear pattern of deviating associations.

Panel B displays predictions regarding the impact of various cash holding determinants on the market value of cash.[8] It does not offer new insights into the differentiation of capital structure theories. Furthermore, the predictions of the pecking-order and trade-off theories overlap with those of the flexibility hypothesis and the hostile takeover defense motive. They regard cash as valuable in two cases: First, when access to capital markets is constrained, as it is for small firms, highly leveraged firms, financially distressed firms, and firms facing high information asymmetries. Second, the value of cash increases when a firm's demand for financing increases, i.e., when growth opportunities and investment activities are high.

The spending hypothesis, the shareholder power hypothesis, and the costly contracting theory provide an opposing pattern of predictions. They perceive cash as valuable when management is strongly controlled, so that shareholders' risk of expropriation is low. Accordingly, the value of cash is expected to increase when a firm's leverage increases because this induces external control by debt providers. Moreover, higher quality corporate governance aligns managerial interests with those of shareholders. Dividend payments may also signal such an alignment. In all these cases, external control is assumed to increase, and thus, the value of cash increases. The effects of profitability, liquidity substitutes and financial distress distinguish the three theories. The spending hypothesis assumes that incremental cash, available through increased profitability or liquidity substitutes, is spent inefficiently, which decreases the value of cash. The costly contracting theory regards profitability and liquidity substitutes as factors that increase a firm's credit rating and thus result in

[8] Section 3.1.2 provides further explanations regarding measurement of the value effects of cash holdings.

more favorable debt covenants. More favorable debt covenants result in lower cash ratios and a rise in the value of cash because the firm is no longer forced to hoard as much cash as formerly. The exact opposite occurs when a firm faces financial distress: the firm's credit rating deteriorates, and stricter debt covenants with higher cash ratios are enforced by debt providers. This increase in the mandatory cash level decreases the value of cash. According to the flexibility hypothesis, cash is held to mitigate underinvestment. The risk of underinvestment and thus the usefulness of cash holdings increase when there is financial distress and decrease when firm profitability or the availability of liquidity substitutes increase. Therefore, the value of the cash stock is positively associated with financial distress and negatively associated with profitability and liquidity substitutes.

In conclusion, the theories that constitute the theoretical foundation of cash holding research make largely overlapping predictions regarding the association between the level and market value of cash and cash determinants. The capital structure theories differ from the others only with regard to their predictions of the effects of profitability and liquidity substitutes. Agency-based theories are more distinctive, as they predict an increase in cash holdings when firms face liquidity constraints or decreased external control. Finally, agency-based theories, focusing on the effect of liquidity constraints, can be distinguished by the effect of profitability, liquidity substitutes, and financial distress on the market value of cash.

3 Empirical research on cash holdings

The prior discussion focuses on the theoretical foundations of cash holding research and the impact of 10 determinants of cash holding derived from this foundation. Empirical research utilizes various models to investigate the impact of these determinants and the questions inherent in the underlying theories. The respective models differ in their analytical scope, and the theoretical determinants of cash holding can be operationalized by numerous proxies that vary in their economic implications.

3.1 Methodologies in cash holding research

Two types of models are used to analyze the determinants and effects of firms' cash policies. First, some models seek to explain why firms hoard cash by estimating the influence of various firm characteristics on the cash ratio. Second, value-of-cash models investigate the effects of cash holdings on firm value. The cash holding variable included in all these models generally consists of a firm's cash and short-term investments.[9]

3.1.1 Cash holding determinants

Equation (1) is a generalized version of the models used to investigate the determinants of decisions to hoard cash. These models use the cash ratio ($Cash_{it}$) as the dependent variable and explain it with various independent variables. X_{1it} denotes the vector of firm-specific determinants, which are the central interest of study, and X_{2it} is the vector of control variables. All variables in eq. (1) are standardized by a common scaling factor. Most studies scale by either total assets or net assets, which equal total assets less cash holdings.

$$Cash_{it} = \alpha + \beta_1 \times X_{1it} + \beta_2 \times X_{2it} + \varepsilon_{it} \quad (1)$$

Cash holding research features three specifications of the generalized cash holding model in eq. (1). The first specification uses the level of cash as the dependent variable. The most prominent versions of this specification are the models of Opler et al. (1999) (OPSW) and Bates et al. (2009) (BKS). Both models include similar explanatory variables in the vectors X_{1it} and X_{2it} and have become the standard in cash holding research.

OPSW employ the following variables: They estimate firm size by the natural logarithm of total assets. The market-to-book ratio and R&D expenditures scaled by net assets are simultaneously included in their models to represent growth and investment opportunities. Additionally, they employ firm leverage, calculated as total debt[10] over net assets. Profitability is estimated by a cash flow-based measure, defined as cash flow scaled by net assets. Net working capital is estimated as current assets minus current liabilities minus cash divided by net assets and represents liquidity substitutes, i.e.,

[9] In Compustat, this information is contained in variable-item #1, labelled "CHE".

[10] This is measured as long-term debt plus short-term debt.

assets that can easily be sold. Capital expenditures scaled by total assets are incorporated as a measure of investment activity. They indicate investments in fixed assets. Dividends are captured by a dummy-variable that takes a value of 1 in years in which dividends are paid and 0 otherwise. The 20-year standard deviation of cash flows serves as an estimate of financial distress respectively of liquidity constraints. A firm is more likely to exhibit financial distress and be constrained in its liquidity if it exhibits volatile cash flows. This variable is measured in two variants: As a firm-specific or industry-specific metric. Finally, OPSW include indicators of the quality of corporate governance, namely, the percentage of insider ownership and a dummy-variable indicating the presence of anti-takeover measures. The interests of managers and owners are expected to be better aligned when managers participate in equity, which represents an increase in the quality of corporate governance. However, when internal ownership becomes too dominant, managers might have an incentive to exploit shareholders. Anti-takeover measures guard managers from external discipline, which may motivate them to act discretionarily. BKS differ from OPSW in using total assets instead of net assets as the scaling factor. Furthermore, they extend the OPSW model by incorporating acquisition expenditures scaled by total assets, which is another proxy for investment activities, into the level-of-cash regression.

Additional variations of the OPSW and BKS models can be found throughout the literature. The quality of corporate governance is not routinely employed as an explanatory variable in subsequent studies. Nevertheless, many studies investigate the link between corporate governance and the cash stock, using variables that differ from those of OPSW to estimate governance quality. Proxies for information asymmetry are the inverse of corporate governance indicators, as high quality corporate governance implies low information asymmetry. The range of governance variables is large, embracing board structure as well as board independence (Harford et al. (2008) and Kuan et al. (2011)), variables that are estimated by the number of external and non-executive board members, board size and CEO duality. Larger board size is usually associated with an increase in agency costs, due to less flexible decision making. However, increased board size is also associated with a rise in monitoring of managerial actions. It is thus not possible to derive a clear prediction regarding the effect of board size. Dummy variables that measure CEO duality indicate the discretionary potential arising from managers that serve simultaneously as CEOs and board directors. Other indicators of the quality of corporate governance are ownership structure (Kuan et al. (2011)), governance indices (Dittmar/Mahrt-Smith (2007)—which mostly indicate anti-takeover measures (Harford et al. (2008))—and managerial compensation (Tong (2010) and Liu et al. (2014)).

Similar diversity is found for variables indicating the probability of financial distress or liquidity constraints. The variability of cash flows, as used by OPSW, is the most frequently applied indicator of financial distress. Variation in cash flows is sometimes replaced by the volatility of earnings or stock returns. The well-known Altman Z-score provides an estimation of the propensity to go bankrupt. Another common indicator is credit rating, as used, for example, by Harford et al. (2008) and Subramaniam et al. (2011). Steijvers/Niskanen (2013) use the length of a firm's relationship with its main bank, measured by the number of months of collaboration, as an indicator of liquidity constraints. Furthermore, they use the Herfindahl index to estimate bank power. A long banking relationship and highly concentrated banking markets are expected to decrease information asymmetries and thus the costs of external financing, lowering the incentive to hoard cash. A final indicator of liquidity constraints is access to external capital. The latter may be indicated by various proxies, such as issuance of convertible debt (Pinkowitz/Williamson (2002)), a dummy indicating that a firm recently went public or the time distance to that event (Chen et al. (2012)), the availability of credit ratings (Opler et al. (1999)), and the size of capital markets (Iskandar-Datta/Jia (2014)). The other cash holding determinants are estimated in more consistent ways, but some variation can still be found. Huang et al. (2015) calculate leverage as total debt scaled by the sum of total debt and the market value of equity. Mikkelson/Partch (2003) and Lee/Lee (2009) include earnings scaled by assets as a proxy for profitability. Net working capital is in rare cases replaced by the cash conversion cycle[11] as an indicator of liquidity substitutes. This variable measures how much time it takes for a company to generate cash from its investments in inventories. Some studies exchange the dividend-dummy for a

[11] Drobetz/Grüninger (2007) use the following formula to calculate the cash conversion cycle: $\frac{Receivables}{Sales} * 360 + \frac{Inventories}{Cost\ of\ sales} * 360 - \frac{Accounts\ payable}{Total\ operating\ expenditures} * 360.$

continuous variable that sets total dividends in relation to assets (Tong (2010)) or net income (Yu et al. (2015)).

The second specification of eq. (1) is introduced by Almeida et al. (2004) and replaces the level of cash with the change in cash, which is the difference between the current and prior level of cash holdings. D'Mello et al. (2008) and Bates et al. (2009) extend this approach by using a first-difference estimator, which also means replacing explanatory level-variables with explanatory change-variables. Using this first-difference estimator has the advantage of accounting for time-constant unobserved heterogeneity, as Bates et al. (2009) argue. However, this can also be achieved by using level-variables in a fixed effects model. Employing changes instead of levels as dependent or explanatory variables also has implications for the research questions that can be addressed and is not an arbitrary choice. For example, Almeida et al. (2004), Riddick/Whited (2009), and Palazzo (2012) develop theoretical models to investigate the relationship between corporate saving and different characteristics of cash flows. They use the change in cash holdings as a proxy for corporate saving. A positive change in cash holdings indicates saving, whereas a negative change indicates spending. Employing the level of cash as the dependent variable in this setting would be misleading because a generally high level of cash is not necessarily related to an increase in the cash stock in a particular period.

The third specification uses excess cash as the dependent variable. The concept of excess cash was introduced by Opler et al. (1999). The underlying idea is to estimate the predicted level of cash for every firm-year, using a model in the style of OPSW. Excess cash is the residual resulting from this procedure, i.e., it is the difference between a firm's actual level of cash and the predicted level of cash. Excess cash is relevant to research questions that investigate deviations from common cash holding policies. That means a researcher is not interested in the determinants of the level of cash but in the determinants of decisions to deviate from the established cash level.

3.1.2 Value-of-cash models

Value-of-cash models are used to analyze the effect of cash holdings on firm value or, alternatively, a firm's stock returns. Two variants of value-of-cash models are applied in research:

First, the current market value of a firm, i.e., the market value of equity plus the book value of debt (MV_{it}), is regressed on cash holdings ($Cash_{it}$) and various control variables. This approach is based on the valuation regression of Fama/French (1998) and was introduced into cash holding research by Pinkowitz/Williamson (2002) and Pinkowitz et al. (2006). Equation (2) shows the regression equation that has become standard in value-of-cash models:

$$\begin{aligned} MV_{it} = {} & \alpha + \beta_1 \times E_{it} + \beta_2 \times dE_{it} + \beta_3 \times dE_{it+1} + \beta_4 \times dNA_{it} + \beta_5 \times dNA_{it+1} + \beta_6 \times RD_{it} \\ & + \beta_7 \times dRD_{it} + \beta_8 \times dRD_{it+1} + \beta_9 \times I_{it} + \beta_{10} \times dI_{it} + \beta_{11} \times dI_{it+1} + \beta_{12} \times D_{it} + \beta_{13} \times dD_{it} \\ & + \beta_{14} \times dD_{it+1} + \beta_{15} \times dMV_{it+1} + \beta_{16} \times Cash_{it} + \varepsilon_{it} \end{aligned} \quad (2)$$

The prefix d indicates change-variables; thus, $dX_{it} = X_{it} - X_{it-1}$. A measure of earnings (E_{it}) that excludes extraordinary items but includes interest, deferred tax credits, and investment tax credits is employed. NA_{it} represents net assets, RD_{it} is research & development expenditures, I_{it} is interest expenditures, and D_{it} is common dividends. All variables are scaled by a common factor, typically net assets or total assets. The regression coefficient of cash holdings, β_{16}, indicates the association of cash holdings with firm value. It provides the basis for claims about the market value of cash. If, for example, the regression coefficient for cash holdings takes a value of 0.8, this indicates that an increase of \$1 in cash is associated with a rise in firm value of only \$0.80. In an alternative specification, Pinkowitz et al. (2006) include the lagged and lead changes of cash holdings in eq. (2). This bears the risk that the change in cash holdings may incorporate expectations about future growth. Thus, empirical research mostly employs the specification in eq. (2).

Second, a measure of stock returns (Ret_{it}) is regressed on cash holdings and various control variables in vector X_{2it}, as shown in equation (3). Ret_{it} can be designed as a buy-and-hold return, as Oler (2008) shows, or an abnormal return, as in Harford (1999) and Faulkender/Wang (2006). Such an abnormal return is calculated by comparing a normal or benchmark return (R_{it}) with a firm's actual return (r_{it}).

$$Ret_{it} = \alpha + \beta_1 \times \frac{Cash_{it}}{MV_{it-1}} + \beta_2 \times X_{2it} + \varepsilon_{it} \quad (3)$$

The interpretation of equation (3) is analogous to that of equation (2). However, the cash holding variable and the control variables contained in X_{2it} must be scaled by the one-year lagged market value of equity (Faulkender/Wang (2006)). This scaling allows the regression coefficient of cash holdings to be interpreted as the dollar change in firm value caused by an incremental $1 in cash.

3.2 Review of empirical results

The empirical evidence presented in this section is derived from the first specification of equation (1) and focuses on the determinants of the level of cash. More specifically, I examine the determinants used in the seminal OPSW and BKS models as well as proxies for financial distress and the quality of corporate governance. The only exception to this is in the final paragraph, which addresses the market value of cash holdings, referring to equations (2) and (3). An overview of the influence of the determinants under analysis is provided in Table 2, which presents the median regression coefficients for every determinant considered from a broad sample of studies. While the OPSW and BKS variables are included in this table, proxies for liquidity constraints, except for cash flow uncertainty, and the quality of corporate governance are not tabulated, as these are too diverse and cannot be generalized in the same way as the other variables. The values of the median regression coefficients are not comparable across studies because they are affected in each case by the specific study design employed. Therefore, rather than the values of the coefficients, the discussion focuses on the signs of the coefficients, major trends, and especially deviations from these trends.

[Insert table 2 about here]

The seminal paper by Opler et al. (1999) introduces the OPSW-model and represents the first application of a full level-of-cash regression. The previous paper by Kim et al. (1998) does not incorporate R&D expenditures, capital expenditures, dividends or a proxy for the quality of corporate governance and thus lacks some central determinants.

The top of Table 2 shows that Opler et al. (1999) find a negative association between the level of cash and total assets, leverage, net working capital, and dividends. A positive relationship is reported between the level of cash and the market-to-book ratio, R&D expenditures, cash flows, capital expenditures, and cash flow uncertainty. Bates et al. (2009) find a negative association between acquisition expenditures and the cash level. Moreover, they confirm the associations found by Opler et al. (1999), except in the cases of capital expenditures and cash flows, which they report to be negatively associated with the level of cash. The results of Opler et al. (1999) and Bates et al. (2009) correspond to the median of results across the sample of studies, shown at the bottom of Table 2. The sample medians confirm the positive relationship between cash flows and the cash level found by Opler et al. (1999) and the negative association between capital expenditures and the cash level reported by Bates et al. (2009).

Despite this large overlap between the sample medians and the results of Opler et al. (1999) and Bates et al. (2009), Table 2 shows that there is no consensus on how individual determinants are associated with the cash stock. In particular, the associations of total assets and to a smaller degree, investment activities, leverage, both profitability indicators, and dividends with the cash level exhibit large variation. Subsequently, I discuss results that deviate from the majority of reported results for every determinant.

Firm size

The majority of studies as well as OPSW and BKS report a negative association between firm size and the level of cash. Table 2 still shows several studies that identify a positive relationship. These positive deviations are mostly found in single-country studies focusing on Asia (Lee/Lee (2009), Chen et al. (2012), and Chen et al. (2014)), other non-US countries (Ozkan/Ozkan (2004) and Lee/Powell (2011)) and US new-economy (Chen (2008)) and technology firms (Chen/Chuang (2009)). In all these cases, country-level information asymmetries are assumed to be higher than in a broad international or US sample.

Thus, the effect of firm size appears to depend on country-level of information asymmetries. When country-level of information asymmetries are low, and shareholders are protected from expropriation, an increase in size might coincide with increasing quality of corporate governance, which decreases

the level of cash, according to agency-based theories. When country-level information asymmetries are high, firm size is not sufficient to create a level of control that would decrease cash holdings.

Investment activities

The majority of studies find a negative association between cash holdings and capital expenditures and between cash holdings and acquisition expenditures, results that appear to conflict with the predictions of all major theories. The spending hypothesis predicts that investment activities will increase with increased cash hoarding, due to discretionary managerial actions. The trade-off theory and pecking-order theory predict that more cash is held in situations of increased investment activity to avoid the costs of external financing.

Studies that use an empirical approach different from that of the standard level-of-cash regression obtain results that suggest a positive association between cash holdings and investment activities. Harford (1999) and Opler et al. (1999) document an increasing likelihood of undertaking value-decreasing acquisitions among cash rich firms. Additionally, Harford et al. (2008) report that cash is spent more quickly on acquisitions and capital investments, but less is spent on R&D, when firms are poorly governed. Denis/Sibilkov (2010) confirm this observation and add that such usage of cash holdings is perceived as value increasing in constrained firms.

This result indicates that cash holdings increase the likelihood of undertaking acquisitions and investments in fixed assets that are financed with cash. The negative coefficient for the investment activity-proxy found in level-of-cash regressions captures the fact that these investments are financed with cash. Thus, these findings are more in line with the spending hypothesis and the precautionary motive, as initially suggested.

Leverage

OPSW, BKS, and most empirical research confirm a negative association between leverage and cash holdings, as seen in Table 2. This is consistent with the flexibility hypothesis as well as the pecking-order and trade-off theories. Similar to the influence of firm size, the association of leverage with cash holdings depends on country-level information asymmetries. As Table 2 shows, a positive association between leverage and the corporate cash level is reported by Kalcheva/Lins (2007), García-Teruel/Martínez-Solano (2008), Chen et al. (2012), and Horioka/Terada-Hagiwara (2013) for non-US firms, which are presumed to be situated in environments with greater agency problems. In these countries, debt providers might be able to limit discretionary behavior. Thus, shareholders allow higher cash reserves in firms that are subject to increased monitoring by creditors. Another possible interpretation is that the positive influence of leverage on cash is enforced by debt covenants, as predicted by the costly contracting hypothesis. These diverging interpretations may be investigated by analyzing how information asymmetries affect the leverage-sensitivity of the market value of cash. In general, agency-based theories gain importance when information asymmetries are more severe.

Profitability

The majority of studies report a positive relationship between profitability and cash holdings. This observation is found in US samples (Harford (1999), Harford et al. (2008), and Denis/Sibilkov (2010)), international samples (Iskandar-Datta/Jia (2014) and Chen et al. (2015)), and Asian samples (Kuan et al. (2011) and Chen et al. (2012)). This can be explained by the pecking-order theory, which assumes that available cash is hoarded to prevent underinvestment. Moreover, the flexibility hypothesis predicts that increased profitability will be associated with increased managerial discretion, leading to cash hoarding behavior. Few studies deviate from the majority result and report a negative relationship between profitability and cash holdings. This observation is not associated with specific regional sample characteristics, as it is in the cases of firm size and leverage. The negative coefficient can be explained by the trade-off theory, which means that the costs of hoarding cash exceed the associated benefits of increasing firm profitability.

Dividends

Table 2 reveals a primarily negative association between dividends and the level of cash which turns positive when country- or industry-level information asymmetries in the study sample are higher than in a standard sample of publicly traded US companies. This is reported by Chen/Chuang (2009) for American technology companies, by Kuan et al. (2011) for a sample of listed Asian companies,

and by Chen et al. (2012) and Chen et al. (2014) for Chinese public companies. Thus, country-level information asymmetries are again found to influence the association between cash holdings and one of their determinants. This result might indicate that dividends do not discipline managerial behavior when a firm faces high country-level information asymmetries. However, dividends might also signal an exceptional alignment between managerial and shareholder interests, which leads shareholders to allow higher cash holdings, in the spirit of the shareholder power hypothesis.

Investment and growth opportunities

The vast majority of studies in Table 2 report a significant positive association between growth/investment opportunities and corporate cash levels, which corresponds to the spending hypothesis, the trade-off theory, and the pecking-order theory.

Bigelli/Sanchez-Vidal (2012) report a negative association between the market-to-book ratio and the corporate cash level and between R&D expenditures and the cash stock. Their sample consists solely of private Italian companies. The Italian setting suggests higher information asymmetries than in the standard US sample. However, private companies should be subject to fewer information asymmetries between its owners and managers because owners are more likely to actively manage the firm. Moreover, private firms rely more strongly on debt financing (Brav (2009) and Saunders/Steffen (2011)). Thus, the motive behind the observed negative association is ambiguous, but trade-off considerations that identify debt as better suited for financing growth opportunities in private companies than cash holdings might play a driving role.

R&D expenditures, used as an indicator of growth/investment opportunities, face a potential measurement problem. Breuer et al. (2016) note that firms decrease their level of cash when their shareholders are ambiguity-averse, i.e., when their investors wish to avoid uncertain investments.[12] The outcome of R&D investment is highly uncertain (Chan et al. (2001) and Dittmar et al. (2003)). Therefore, ambiguity-averse shareholders prefer lower R&D investment as well as a lower level of cash, if cash is primarily used to finance R&D. Thus, it is unclear whether the effect of R&D expenditures is exclusively based on the presence of growth/investment opportunities, driven by the association of growth opportunities and information asymmetries or also due to the ambiguity aversion of investors.

Liquidity substitution

Both indicators of the availability of liquidity substitutes, namely, net working capital and the cash conversion cycle, are found to be negatively associated with cash holdings. This result coincides with the trade-off theory. Horioka/Terada-Hagiwara (2013) object to the majority of results. They provide further evidence of the impact of country-level information asymmetries on the determinants of cash holdings, reporting a positive association between net working capital and the level of cash in emerging Asian markets. This is in line with the spending hypothesis and the pecking-order theory, both of which predict that cash holdings will rise because of managerial discretion or high costs of external financing caused by increased information asymmetries. Thus, the pecking-order theory and the spending hypothesis appear to gain explanatory power in an environment of high information asymmetry.

Probability of financial distress and liquidity constraints

Overall, the majority of studies indicate that the level of cash increases when the probability of financial distress rises. This positive association is consistently reported when cash flow uncertainty (Tong (2010), Iskandar-Datta/Jia (2014), and Chen et al. (2015)), credit ratings (Opler et al. (1999) and Subramaniam et al. (2011)), and the power of banks (Steijvers/Niskanen (2013) and Yu et al. (2015)) are used as indicators. This result is due to the increased cost of external financing and information asymmetries that accompany financial distress, as predicted by all major theories.

Evidence regarding the influence of access to external capital on the level of cash holdings is mixed, with Iskandar-Datta/Jia (2014) reporting a significant positive association, whereas Chen et al.

[12] Ambiguity aversion describes an individual's preference for known risks over uncertain risks. In contrast, risk aversion concerns situations in which risks are certain and can be assessed by their expected value. Finally, information asymmetries differ from both concepts, as they focus on the unequal distribution of certain information between different parties.

(2015) report a negative one. The former use the size of equity, credit, and bond markets, whereas the latter use a mix of equity market size, index affiliation, and foreign ownership to indicate the accessibility of capital markets. The negative association obtained by Chen et al. (2015) results from the foreign ownership variable, which might also capture the increased quality of corporate governance and not only access to capital markets.

Another area of ambiguity is the impact of financial distress, as measured by Altman's Z-score. The variable is found to be insignificant, with the sign of the respective regression coefficient varying, according to Drobetz/Grüninger (2007), García-Teruel/Martínez-Solano (2008), Lins et al. (2010), and Neamtiu et al. (2014). This might be due to two conflicting effects: First, a firm under severe financial distress cannot raise external capital; thus, it is expected to use its cash reserves and has an incentive to increase the cash balance. Second, in such illiquid situations, it is usually not possible to increase cash reserves because cash is immediately spent.

Information asymmetries and corporate governance

The general notion of indicators of the quality of corporate governance or, alternatively, information asymmetries across the majority of studies is that increased information asymmetries and decreased quality of governance are associated with a rise in the corporate cash level. This result is unambiguous when governance indices are applied (Dittmar et al. (2003), Harford et al. (2008), Tong (2010), Subramaniam et al. (2011), and Chen et al. (2014)).

A more mixed relationship is found between ownership and the level of cash. Family ownership is positively associated with cash holdings, as Dittmar et al. (2003), Kuan et al. (2011), and Steijvers/Niskanen (2013) show. Family owned firms are more likely to be actively managed by their owners and less likely to appoint external managers. Therefore, cash hoarding is allowed because the family-owners can control the use of the cash stock and need not fear expropriation, as the shareholder power hypothesis suggests. Measures of managerial ownership indicate more ambiguous results. Opler et al. (1999), Ozkan/Ozkan (2004), and Kuan et al. (2011) find that cash holdings decrease with internal ownership. This observation is in line with the flexibility and spending hypotheses. The interests of management and shareholders are aligned as a result of having managers participate in equity. This alignment of interests results in a decline in discretionary behavior that leads to a reduction in the cash level. The contrary finding of a positive association is provided by Kalcheva/Lins (2007), Harford et al. (2008) and Yu et al. (2015). The differences in the association between managerial ownership and the cash level cannot be attributed to regional differences of the respective studies' samples. Negative and positive relationships are documented in U.S. as well as international samples. The divergence of results suggests a non-linear relationship between internal ownership and cash hoarding. A moderate level of managerial ownership aligns the interests of shareholders and managers, which results in a decrease in the cash stock, as predicted by the flexibility and spending hypotheses. However, when management's share in the firm becomes too large, managers tend to exploit minority shareholders. Such tunneling behavior is documented by Yu et al. (2015) and Liu et al. (2015).

Board size is another area of ambiguity. Harford et al. (2008), Belghitar/Clark (2014) and Neamtiu et al. (2014) find a negative relationship between board size and cash holdings in UK and US firms. A positive association is documented when information asymmetries are more pronounced, as in the case of Asian (Lee/Lee (2009)) and US high-tech firms (Chen/Chuang (2009)). Consequently, board size is an effective instrument for mitigating cash hoarding when country-level information asymmetries are low or shareholders are better protected. Similar findings are not obtained when board composition is considered. Belghitar/Clark (2014) report a positive association between board independence, indicated by the ratio of non-executive members to all board members, and cash holdings in the UK. In contrast, Ozkan/Ozkan (2004), Harford et al. (2008), and Lee/Lee (2009) document a negative association. The association between CEO duality and the corporate cash level appears to be positive, which confirms the discretionary nature of such dual positions, in accordance with the flexibility and spending hypotheses, as Lee/Lee (2009), Kuan et al. (2011), and Yu et al. (2015) report.

In summary, the influence of corporate governance depends on country- or industry-level information asymmetries. In general, predictions of the flexibility and spending hypotheses appear to hold, which means that decreases in information asymmetries reduce discretionary managerial behavior and initiate a decrease in cash holdings. However, in an environment of low information

asymmetries and strong shareholder protection, an incremental increase in corporate governance quality encourages shareholders to allow higher cash holdings, as predicted by the shareholder power hypothesis.

Market value of cash holdings

In the early stages of empirical research on cash holdings, cash was perceived as destroying firm value, as Harford (1999) states in his seminal paper. This implies that an incremental dollar held in cash should increase firm value by less than a dollar. Accordingly, Faulkender/Wang (2006) find that $1 in cash increases firm value by only $0.94, on average. A larger spread is documented by Kalcheva/Lins (2007), who find that an incremental $1 in cash raises firm value by $0.76 to, and Dittmar/Mahrt-Smith (2007), who report that $1 held in cash raises frim value by between $0.42 and $0.88 in firms subject to weak corporate governance. The negative value effect is also found when excess cash is employed instead of cash holdings, as Dittmar/Mahrt-Smith (2007), Frésard/Salva (2010), Martínez-Sola et al. (2013), or Huang et al. (2013) observe.

Various factors may alter the negative perceptions of cash holdings in the capital market. The quality of corporate governance is shown to be positively associated with the market value of cash holdings. Frésard/Salva (2010) find that $1 in excess cash held by firms that are cross-listed in the US corresponds to an increase in firm value of between $1.23 and $2.17. Cross-listings are expected to decrease information asymmetries, due to increasing disclosure requirements, stricter legal environments, and increased monitoring. This increased external discipline ensures that cash is spent more efficiently, which increases the value of cash. Complementary to this observation, Pinkowitz et al. (2006), Dittmar/Mahrt-Smith (2007), Harford et al. (2008), Lee/Lee (2009), and Kusnadi (2011) document that the market value of cash increases with the quality of corporate governance.

Furthermore, several authors recognize that the value of cash increases with the presence of liquidity constraints. Faulkender/Wang (2006) and Denis/Sibilkov (2010) show, for US-samples, that cash is more valuable in constrained firms, using dividends, firm size, and firm ratings as criteria of financial constrainedness. Chen et al. (2009) observe that the interplay between corporate governance quality and liquidity constraints determines the market value of cash. They find that the value of cash increases in firms that are well governed, an effect that is more pronounced in young and growing firms, which tend to have more stringent liquidity constraints than mature firms.

Another value-increasing factor is the persistence of a firm's cash holding policy, as Mikkelson/Partch (2003) note. They find that persistently high cash reserves do not affect firm performance negatively but improve a firm's competitiveness. Martínez-Sola et al. (2013) and Oler/Picconi (2014) corroborate this finding, reporting that deviations from the long-term cash level are associated with decreasing firm value and profitability.

Finally, Breuer et al. (2016) introduce ambiguity aversion as another factor that alters the valuation of cash holdings. They document that the value of cash decreases as ambiguity aversion increases, i.e., when investors aim to avoid information uncertainty. Ambiguity-averse investors perceive risky investments as less valuable. Thus, the cash stock is less valuable to these investors because it is used to finance uncertain investments. This result corresponds to the flexibility hypothesis, which proposes that cash holdings are maintained to ensure the execution of future investments.

3.3 Avenues for future research

The above discussion of cash holding theories and related empirical results has four implications for future research. First, the discussion of cash holding theories shows that cash holding research has a diverse foundation consisting of several distinct theories. While the individual meanings of these theories has been well investigated, the interplay between them has not yet been a focus of research. It is an interesting prospect for future research to compare the relative importance of different cash holding theories and identify situations in which the relative importance changes. One way to analyze the interplay between theories would be through life-cycle models, which are currently utilized in two working papers (Dittmar/Duchin (2011) and Drobetz/Halling/Schroeder (2015)). These models are used to investigate how the level of cash and the association between the level of cash and its determinants changes over a firm's life. A firm life consists of different stages that feature different firm and environmental characteristics. Such research may aid our understanding of how the importance of underlying theories and the links between theories change over different stages of a

firm's life, i.e., in the presence of different firm characteristics and environmental situations. For example, young and growing firms are subject to greater information asymmetries and have greater difficulties obtaining external finance. Thus, life-cycle models could reveal that considerations based on the pecking-order theory and agency-based theories are more relevant for these firms. The trade-off theory may gain importance when firms grow more mature and must consider issues other than external financing when determining their cash stock.

Second, a review of the empirical results of cash holding research suggests that country-level characteristics affect the association between firm-level characteristics and cash holdings. Current research investigates the influence of either country-level characteristics or firm-level characteristics on cash holdings but neglects their interaction. Study of this interaction may reveal information about how country-level effects influence the level of cash. Thus, research should not only focus on whether specific country characteristics are associated with changes in the level of cash but also seek to identify how they become effective. This implies that the level of cash not only changes because of a direct association with specific country characteristics but also because country characteristics affect how firm-level characteristics influence the level of cash. For example, Huang et al. (2013) and Iskandar-Datta/Jia (2014) find that firms subject to low country-level investor protection hold smaller cash reserves. Iskandar-Datta/Jia (2014) report that this observation is driven by a direct link between investor protection and cash holdings, which implies that firms in an environment characterized by low investor protection tend to spend their cash quickly by overinvesting. Huang et al. (2013) also show an indirect link between the level of cash and investor protection. They find that the positive association between corporate governance and the level of cash is more pronounced when investor protection is low. This implies that investor protection alters the association between firm-level governance and the cash level, revealing an indirect route by which country characteristics affect cash management.

Third, the value of cash depends on information asymmetries, liquidity constraints, and the persistence of cash holding policies. While the first two aspects are broadly analyzed in existing research, the final one receives little attention. Empirical investigations either focus on market perceptions of deviations from the long-term normal cash level (Oler/Picconi (2014)) or analyze what these abnormal cash holdings are used for. Accordingly, Opler et al. (1999) find that deviations from the long-term level of cash are associated with increased acquisitions and higher payouts to shareholders. This association is more pronounced in countries with weak investor protection (Iskandar-Datta/Jia (2014)), firms that face financial distress, and firms in which managers are entrenched (Sheu/Lee (2012)). The question of what determines the persistence of the cash level is not considered. Answering this question might reveal effective instruments to avoid value-destroying cash regimes by inducing a long-term orientation to cash management as well as strategic planning in general.

Fourth, Breuer et al. (2016) show that ambiguity aversion influences the level and the market value of cash. This observation reveals potential measurement problems in existing cash holding research. R&D expenditures as a determinant of cash holdings may not only represent available growth/investment opportunities but also capture ambiguity aversion. A similar concern can be raised regarding information asymmetries, which are often present in firms with larger volumes of uncertain investments, for example, high-growth and young firms. Consequently, a further objective of future research may be to disentangle ambiguity aversion, growth/investment opportunities, and information asymmetries.

4 Conclusion

Study of the corporate cash stock has been a growing trend in empirical research since 1999. Cash holding research is characterized by substantial diversity in its theoretical bases and associated empirical results. This literature review serves as an introduction to this field of research and a summary of its current state. Moreover, this review identifies new insights that arise from aggregating research results. Overall, this review provides three contributions: First, the theories upon which cash holding studies rest are disentangled and structured. Second, the most common determinants of the level and market value of cash holdings are identified, and their predicted effects are discussed. Finally, common empirical approaches are identified, observed results associated with these approaches are discussed, and unanswered questions and implications for future research are introduced.

Overall, I investigate 10 determinants of the level and market value of cash holdings, namely, firm size, investment and growth opportunities, leverage, profitability, liquidity substitution, information asymmetries, corporate governance, financial distress, investment activities, and dividends. In general, the level of cash increases when growth opportunities, profitability, or liquidity constraints increase. A negative relationship is documented between the level of cash and firm size, leverage, liquidity substitutes, investment activities, and dividends. The value of cash is reported to increase when firms are financially constrained, when the quality of corporate governance is high, when the level of information asymmetries is low, or when the level of cash is persistent. The market value of cash declines when shareholders are ambiguity-averse

There exist several deviations from these general associations. The influences of many determinants depend on country- or industry-level characteristics. For example, the level of cash and its value increase with the quality of corporate governance and when a firm is located in a country with strong shareholder protection, as suggested by the shareholder power hypothesis. However, in an environment of low shareholder protection, high quality corporate governance influences the cash level negatively, as predicted by the flexibility and spending hypotheses. Existing research focuses on the impact of either country- or firm-level characteristics on cash holdings but ignores their interaction effect. Investigating this interaction is a perspective for future research.

Reviewing the empirical evidence reveals further avenues for future research. Individual theories of cash hoarding are well understood. However, the interplay between these numerous theories is not yet on the research agenda. Persistence of cash holdings is reported to increase the value of cash. Thus, analyzing the determinants of cash holding persistence is a prospect for future research because it may reveal instruments that can be used to induce value-increasing cash policies. Another task is separating the effect of ambiguity aversion on the level and value of cash holdings from that of R&D expenditures or, alternatively, information asymmetries.

Table 1 Influence of distinct determinants on cash holdings according to alternating theories

Panel A - Influence on cash holdings

	Firm size	Investment/growth opportunities	Leverage	Profitability	Liquidity substitution	Information asymmetries	Corporate governance	Financial distress/ liquidity constraints	Investment activity	Dividends
1 - Capital structure theories										
Trade-off theory	-	+	-	na	-	+	-	+	+	-
Pecking-order theory	-	+	-	+	+	+	-	+	+	-
2 - Principal-agent conflicts										
Flexibility hypothesis	-	+	-	-	-	+	-	+	+	-
Spending hypothesis	-	+	-	+	+	+	-	+	+	-
Shareholder power hypothesis	+	-	+	na	na	-	+	+	-	+
Costly contracting theory	-	+	-	-	-	+	-	+	+	-
Hostile takeover defense	-	+	-	na	+	+	-	+	+	-

Panel B - Influence on market value of cash holdings

	Firm size	Investment/growth opportunities	Leverage	Profitability	Liquidity substitution	Information asymmetries	Corporate governance	Financial distress/ liquidity constraints	Investment activity	Dividends
1 - Capital structure theories										
Trade-off theory	-	+	-	na	-	+	-	+	+	-
Pecking-order theory	-	+	-	na	na	+	-	+	+	-
2 - Principal-agent conflicts										
Flexibility hypothesis	-	+	-	-	-	+	-	+	+	-
Spending hypothesis	+	-	+	-	-	-	+	-	-	+
Shareholder power hypothesis	+	-	+	na	na	-	+	+	-	+
Costly contracting theory	+	-	+	+	+	-	+	-	-	+
Hostile takeover defense	-	+	-	na	+	+	-	+	+	-

"-"/"+" denotes a negative/postive influence of the respective determinant on the level of cash holdings (Panel A)/the market value of cash (Panel B).
"na" denotes that no clear prediction of the influence of the respective determinant on the level of cash holdings (Panel A)/the market value of cash (Panel B) could be derived or the determinant has no influence.

Table 2 Empirical influence of various determinants on the level of cash holdings

	Determinants											
	Firm size	Investment/growth opportunities		Leverage	Profitability		Liquidity substitution		Investment activity		Dividends	Cash flow uncertainty
Authors	Total assets	Market-to-book ratio	R&D expenditures		Cash flow-based	Other	Net working capital	Cash conversion cycle	Acquisition expenditures	Capital expenditures		
Opler et al. (1999)	***-0.046***	***0.152***	***1.308***	***-3.037***	***0.310***		***-0.814***			***0.321***	***-0.126***	***0.955***
Bates et al. (2009)	***-0.009***	***0.016***	***0.065***	***-0.368***	***-0.002***		***-0.203***		***-0.193***	***-0.259***	***-0.043***	***0.151***
Kim et al. (1998)	-0.001	0.009		-0.235	-0.014	-0.126		-0.00015				0.010
Harford (1999)		0.057			0.547							0.748
Pinkowitz/Williamson (2001)	-0.116	0.085	2.169	-0.530	-0.508		-0.803			-1.172	0.116	0.164
Dittmar et al. (2003)	-0.650	-0.080	1.680	-1.170	1.060		-0.840			-0.330	-0.180	
Almeida et al. (2004)	0.002	0.004		0.259	0.045		-0.001		-0.400	-1.096		
Ozkan/Ozkan (2004)	0.001	0.023		-0.063	-0.208		-0.073				-0.004	0.091
Acharya et al. (2007)	-0.008	0.005		-0.326	0.053							
Drobetz/Grüninger (2007)	-0.390	0.002	0.091	-2.559	1.928	-0.032		-0.00010			0.445	4.186
Foley et al. (2007)	-0.098	0.044	6.884	-1.952		0.704				-2.646	-0.251	3.358
Kalcheva/Lins (2007)	0.055			0.297	1.851	0.001	-1.766			-0.015	-1.222	
Chen (2008)	0.011	0.017	0.176	-0.044	-0.064		-0.301			-0.465	-0.047	0.020
D'Mello et al. (2008)	-0.030	0.007	1.127	-0.282	0.165	0.139	-0.236			-0.192		-0.372
Garcia-Teruel/ Martinez-Solano (2008)	0.005	0.005		0.001	0.079		-0.153					
Harford et al. (2008)	0.011	0.003	0.915	-0.422	0.491		-0.657		-2.150	-2.998	-0.084	0.589
Chen/Chuang (2009)	0.030	0.010		-0.050	0.100		-0.190			-0.150	0.040	-0.010
Lee/Lee (2009)	0.010	-0.072		-1.839	0.008	0.072	-0.554			-0.362	-0.098	0.025
Riddick/Whited (2009)		0.129			-0.014							
Denis/Sibilkov (2010)					0.197		-0.136		-0.115	-0.015		
Duchin (2010)	-0.016	0.065			-0.137		-0.108					0.063
Lins et al. (2010)				0.911		0.438	-0.082				1.746	0.382
Tong (2010)	-0.019	0.025	0.114	-0.196		-0.173	-0.188			-0.065	-0.969	0.496
Al-Najjar/Belghitar (2011)	-0.014	0.000		-0.134		-0.001	-0.120				-0.002	0.021
Khieu/Pyles (2012)	-0.017	0.006	0.002	-0.098	0.181		-0.108			0.043	-0.016	0.000
Kuan et al. (2011)	0.030	0.010	0.060	-0.390	0.350		-0.470			-0.240	0.340	
Kusnadi (2011)	0.050			-2.420	3.040	0.320	-0.480			0.670	-0.510	4.360
Lee/Powell (2011)	0.007	0.018		-0.385	0.502		-0.172			0.382		0.337
Subramaniam et al. (2011)	0.001	0.015	0.018	-0.297	-0.027		-0.288			-0.293	-0.020	0.040

Table 2 Continued

	Determinants											
	Firm size	Investment/growth opportunities		Leverage	Profitability		Liquidity substitution		Investment activity		Dividends	Cash flow uncertainty
Authors	Total Assets	Market-to-Book ratio	R&D expenditures		Cash flow based	Other	Net working capital	Cash conversion cycle	Acquisition expenditures	Capital expenditures		
Alvarez et al. (2012)	-0.032			-0.019			-0.019					0.040
Bigelli/Sanchez-Vidal (2012)	-0.005	-0.050	-0.060				-0.201				0.020	0.286
Chen et al. (2012)		0.006		0.335	0.488	-0.025	-0.013			-0.074	0.034	0.570
Julio/Yook (2012)	-0.001	0.029		-0.224	-0.049					-0.050	-0.023	1.017
Sun et al. (2012)	-0.010	0.001	0.000	-0.030	0.011		-0.015		-0.193	0.005	-0.018	0.177
Palazzo (2012)	0.002	0.004		0.077	0.061	0.083				-0.274		
Brisker et al. (2013)	0.000	0.000	0.314	-0.157	0.004		-0.404		-0.326	-0.499	-0.033	0.000
Horioka/Terada-Hagiwara (2013)	0.001	0.003		0.439	0.144		0.232			-0.051		
Huang et al. (2013)	-0.088	0.006	4.324	-0.723	-0.055		-0.779			0.651	0.172	0.116
Steijvers/Niskanen (2013)	-0.065	0.001		-0.006			-0.014					
Yu et al. (2013)	-0.004	0.017	0.251	-0.078	0.132		-0.100			-0.049	0.001	
Belghitar/Clark (2014)	-0.011	0.015	0.011	-0.001						-0.244		0.011
Chen et al. (2014)	0.015	0.219		-1.309	1.246		-0.589			-0.734	0.336	6.120
Harford et al. (2014)	0.232	0.122	0.595	-0.701		0.466	-2.205		-2.243	-1.696	-0.185	0.109
Hill et al. (2014)	-0.080	0.066	0.024	-0.209	0.683		-0.362			-1.195	0.025	2.117
Hoberg et al. (2014)	-0.042	0.039	0.046			-0.001			-0.001	-0.024		0.014
Iskandar-Datta/Jia (2014)	-0.011	0.010	0.022	-0.243	0.015		-0.195			-0.216	-0.003	0.149
Liu et al. (2014)	-0.081	0.090	1.502	0.048	-0.006		-0.403		-0.395	-0.128	-0.009	0.041
Neamtiu et al. (2014)	0.000	0.002	0.004	-0.013	0.362		-0.026			-0.540	-0.002	0.013
Oler/Picconi (2014)	-0.062	0.035	0.105	-1.152	-0.044		-1.329		-0.232	0.576	-0.013	0.160
Qiu/Wan (2014)	-0.025	0.013				0.006						0.001
Chen et al. (2015)	-0.004	0.011	0.185	-0.332	0.054		-0.227					0.175
Elyasiani/Zhang (2015)	-0.177	0.058		-0.115		0.266	0.014					-0.360
Liu et al. (2015)	0.020			-0.150	0.040						-0.170	
Total	***-0.0218***	***0.0355***	***0.9340***	***-0.5610***	***0.2880***	***0.1310***	***-0.4600***	***-0.0001***	***-0.8720***	***-0.3770***	***-0.0017***	***0.700***

The values in table 2 are the median regression coefficients of variables which were used as regressors in a level-of-cash regression (1. specification of eq. (1)). The lines of the first column indicate from which study the respective median regression coefficients were obtained. Each of the residual columns represents one cash holding determinant as indicated in the heading of the columns. The total value at the bottom of table 2 is the median across all studies. A missing number indicates that a study did not test for the respective determinant.

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Teil 3

Regional Differences in the Determinants of Cash Holdings

Regional Differences in the Determinants of Cash Holdings

J. Felix Weidemann*

Abstract

This study documents the existence of interaction effects between regional and firm-level determinants of the corporate cash level. Moreover, this article explores how empirical design choices affect the results of primary research on the determinants of cash holding. Identifying regional interaction effects highlights that regional characteristics not only affect the level of cash directly but also have an indirect influence by altering the association of various firm-level determinants with cash holdings. This indirect effect of regional characteristics on the cash level has been ignored by prior research and needs to be investigated to fully understand why and how regional characteristics affect cash holdings. This study documents that firm-level characteristics have similar associations with cash holdings in the US and Europe but different associations in Asia. Differences in Asian firms may result from country-level agency concerns or a lack of financing alternatives. This observation is not explained unambiguously by a country's development, the size of equity markets, legal tradition, time trends, and the presence of unique firms with high information asymmetries. Investigating empirical design choices reveals that employing an instrumental variable or difference-in-differences approach instead of standard OLS models alters the influence of cash holding determinants, implying endogeneity in existing research. (*JEL* G31, G32, G34)

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Keywords: Corporate cash holdings, meta-regression, geographic region, empirical design

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This article contributes to research on the determinants of cash holdings in two ways. First, it provides evidence on the existence of an interaction effect between firm-level characteristics and geographic regional characteristics as determinants of the corporate cash level. Prior research discusses various motives to hold cash intensively and identifies the influence of various regional (Julio/Yook, 2012; Huang et al., 2013; and Chen et al., 2015) as well as firm-level determinants on the level of cash. However, an interacted effect of these regional and firm-level characteristics in determining the cash holdings has been ignored.

This observation of an interaction effect is important because it points out a new avenue for future research that leads to a better understanding of how firms determine their cash stock. Specifically, it shows that it is a meaningful and unexplored question to ask how regional characteristics can have an effect on the level of cash, i.e. asking which corporate decisions change because the regional characteristics in which a firm is situated are altered. This research question assumes that the level of cash does not only change because of the presence of a specific regional characteristic, i.e. a direct link between the regional characteristic and the cash level, but also because the regional characteristic affects how other firm-level characteristics are associated with the level of cash, i.e. an indirect or interacted effect. Ultimately, investigating the interaction effect of firm- and regional-level characteristics as explaining factors of the corporate cash stock means figuring out the specific routes how regional- or country-level characteristics influence the level of cash and providing a deeper understanding of how the framework of decisions on the corporate cash stock is affected by these characteristics.

Second, this study investigates how the empirical design of cash holding studies influences their results. This provides guidance for future research regarding the most critical design decisions as well as the areas which are most prone to be influenced by these decisions. Determining the underlying empirical method of a study appears to be the most crucial decision in the empirical set-up. The association between individual firm-level

determinants and the level of cash differs when instrumental variables or a difference-in-differences approach are employed instead of a standard OLS regression. Studies which do not employ these methods may suffer from endogeneity and are unable to provide causal inferences. This effect is especially pronounced when the influence of total assets, dividends, and corporate governance on the cash level is investigated. Including fixed effects to standard OLS models is routinely advised. The analysis also points out that the inclusion of industry and time fixed effects changes the influence of various firm-level determinants on cash holdings. Finally, the definition of the cash holding variable and a study's source of data have either no influence or the effect cannot be distinguished from country-level characteristics.

The empirical analysis in this study unfolds in three steps. First, I estimate the consensus association, i.e. the average association across existing studies, between the level of cash held by a firm and each of the ten most prominent firm-level determinants of cash holdings. Second, I show that these consensus associations differ by geographic regions and are influenced by the empirical design of primary research. Finally, I investigate if macroeconomic characteristics such as a country's development, the size of equity markets, or legal tradition can explain geographic differences in the consensus associations.

I utilize the concept of meta-regression analysis (MRA) to undertake a quantitative review of the cash holding literature and to address all three steps of the analysis. MRA allows the empirical measurement of trends in research results by using the existing research as its sample. The method is well suited to investigate the existence of regional differences in the determinants of the cash level as well as the influence of empirical choices on the results of primary research. Firstly, undertaking a firm-level analysis of the interacted influence of various firm-level characteristics and regional characteristics on the level of cash requires various exogenous shocks or valid instruments on the firm level or on the regional level as well as an extensive data set of international firm data. Both are difficult to find for ten distinct firm-level determinants. Therefore, MRA offers an alternative to prominent quasi-

experimental techniques because it aggregates diverse time periods, firm samples, estimation techniques, control variables, variable definitions, and weights the derived research results by their precision. This provides insights that are more robust than standard firm-level analysis in absence of exogenous shocks or valid instruments. Secondly, it is the main purpose of meta-regressions to analyze how the characteristics of primary research affect its results. Thus, it is an ideal methodology to investigate how empirical design choices that were employed influence the results of primary research as Égert/Halpern (2006) show.

Results from the meta-regressions reveal the consensus association between each of the most frequently investigated determinants and the level of cash. Cash holdings decline when total assets, investment activities[1], net working capital, leverage, cash flow, and dividends increase. The corporate cash reserves increase with an increasing market-to-book ratio, R&D expenditures, financial distress, and corporate governance quality. Moreover, the MRAs exhibit that firm-level characteristics affect cash similarly in US and Europe but different in Asia or the global sample.[2] Finally, these regional differences are not entirely explained by specific country characteristics like the relevance of a country's equity market, and a country's development or time trends. A country's legal tradition appears to drive many of the regional differences implying that investor protection affects the impact of firm-level cash holding determinants. However, this study can only investigate legal tradition in a very small sample. Consequently, there is an interaction between regional characteristics and the effect of firm-level determinants on the level of cash but individual driving country characteristic can only be hinted.

MRAs indicate that the design of empirical research is especially important when the association between cash holdings and total assets, dividends, and corporate governance is investigated. Including industry and time fixed effects to standard OLS models is routinely

[1] Investment activities comprise capital expenditures and acquisition expenditures.

[2] These regions refer to geographical, not political regions. Thus, Europe also includes Switzerland. The global sample refers to primary samples comprising several geographic regions, see section 3.3.

advised and affects the association of net working capital, leverage, and financial distress with cash holdings. The choice of the underlying database of primary empirical research also affects the associated results, but to a smaller degree. This effect partially overlaps with the influence of regional characteristics because hand collected data sets are more often used when regions are investigated that are not fully covered by standard databases such as Compustat. Finally, the definition of the dependent cash holding variable does not influence the results of primary research.

The reported results on regional differences provide two possible explanations for the differences in Asia. First, information asymmetries might be smaller in US and Europe than in Asia, because the legal system protects investors better and provides more external discipline. This suggests a greater relevance of the FCF-hypothesis in Asia (Claessens/Fan 2002). Second, Asian firms might lack alternatives in external financing; i.e. they have a more constrained access to capital markets (Claessens et al. 1999, Allayannis et al. 2003, Allen et al. 2005), suggesting a greater relevance of the underinvestment problem. The prior indications are based on the observed regional differences in the impact of individual firm-level determinants. Thus, they require more intensive investigation to derive causal inferences, which is an interesting perspective for future research.

The meaning of the firm- and regional-level interaction found in this meta-study can be highlighted in a more straightforward way with an illustrative example. A frequently investigated regional, respectively country-level characteristic is investor protection. The direct effect of investor protection is documented in the existing literature. Dittmar et al. (2003) and Huang et al. (2013) show in international samples that until the year 1998 the level of cash decreases when investor protection increases. After 1998, Huang et al. (2013) report the cash level to increase when investor protection increases. This change in the association between cash holdings and investor protection is explained by the emerging market financial crisis in 1998 that made investors more aware of protecting the corporate

cash stock. The mentioned studies only regard the direct link between cash holdings and investor protection. They do not explicitly investigate how better investor protection increases the cash level in the post 1998 period but assume that this increase is exclusively achieved by investors allowing higher cash stocks when they are well protected.

Kalcheva/Lins (2007) implicitly investigate the interaction between corporate governance and investor protection as explanatory factors of the cash level in an international sample. They study how managerial entrenchment, indicated by firm-level measures of management control rights, affects the level of cash in different regimes of country-level shareholder protection. Their results show that entrenched managers hoard more cash when investor protection is low. In contrast, entrenched managers do not influence the cash level in countries with high investor protection. This means that investor protection does not only directly increase the level of cash but also alters the influence of entrenched managers on the cash level. There are potentially many more unexplored avenues how investor protection achieves its cash-increasing effect found in Huang et al. (2013). This meta-study is not able to identify these specific avenues because it cannot investigate individual country-level characteristics but has to focus on more general regional characteristics. Instead, the study points out that there is an interaction effect between regional characteristics and various firm-level drivers in the explanatory function of cash holdings which highlights the potential for future research on individual firm- and country-level interaction effects.

Exemplarily, Asian countries typically feature lower investor protection than the US. Thus, the effect of the Asian regional dummy in the meta-regressions embraces the effect of investor protection on the determinant-elasticities of cash holdings. Referring to the results from my MRAs, this would mean that low investor protection increases the cash level by making large firms, firms with many fixed assets and growth firms hoard more cash. Contrarily, firms with high net working capital or leverage decrease cash holdings in an environment of low investor protection. However, the Asian regional dummy is not limited to

include only the effect of investor protection but also incorporates other characteristics of the Asian region. Therefore, it is not possible to attribute the regional effects unambiguously to one specific country-level characteristic such as investor protection. Instead, this example illustrates how future research can improve the understanding of how country characteristics influence specific corporate decisions and especially the determinants of cash management. This study shows the relevance of such research questions and identifies areas, i.e. firm-level determinants and geographic regions, which are promising to investigate.

The remainder of this study is structured as follows: Section 1 reviews theories of cash hoarding, identifies the most common firm-level determinants, and discusses indications of regional differences in the effect of these determinants. Section 2 introduces the general methodology of MRA, my specific research design, and descriptive statistics. Results, consisting of graphical, univariate as well as multivariate analyses, and robustness checks, are presented in section 3. I conclude in section 4.

1 Theory and literature review

1.1 Theoretical foundation

Cash holding research is characterized by a great diversity in its theoretical foundation as well as in the empirical approaches employed. The variety of theoretical perspectives leads to a large number of determinants that are assumed and reported to influence the level of corporate cash. The central questions of this study arise from these characteristics of cash holding research. First, existing research focusses either on firm-level determinants or on regional-level determinants of cash holdings but does not explore whether regional characteristics alter the association between firm-level determinants and the level of cash. The large number of distinct determinants makes it difficult to set up a model with primary data that is able to investigate an interaction between regional characteristics and various firm-level characteristics. Either a researcher chooses one specific firm-level determinant and

investigates whether regional characteristics affect its association with the level of cash or a meta-methodology is employed to explore interaction effects for various firm-level determinants. Second, considering the large number of existing research it is unclear how the individual empirical study design affects results regarding the drivers of the cash level.

Both research questions result from the diverse theoretical foundation of cash holding research which consists of two strands. These are classic capital structure theories and agency-based theories. The prior derive statements regarding a firm's entire financing decisions, the latter focus on how the relation between the management and its shareholders or other stakeholders affects the cash level.

Two major capital structure theories are regarded in cash holding research. The trade-off theory originates from Modigliani/Miller (1963) who extend their original model by including taxes. Trade-off theory adds the risk of bankruptcy to the M/M-model and compares it to the benefits of tax-deductibility of corporate debt. The result of this trade-off is an optimal level of debt.[3] When applied in cash holding research, the trade-off theory compares the costs and benefits of holding cash and assumes that firms have an, optimal, target level of cash.

The pecking-order theory, introduced by Myers/Majluf (1984) who build on the work of Donaldson (1961), does not feature the assumption of an optimal level of debt or a target level of cash but suggests a strict hierarchy of financing that aims to avoid underinvestment. This hierarchy is induced by ex-ante information asymmetries that prevent potential investors from assessing a firm's true value. Consequently, signaling makes external financing costly and secondary to internal financing. Within external financing, debt financing is preferred over issuing equity.

Various agency-based theories are used to explain the level of cash. The most prominent is the FCF-hypothesis, according to Jensen/Meckling (1976). It regards cash holdings as the

[3] See Frank/Goyal (2008) for a general introduction and Bradley et al. (1984) as a classic example.

result of discretionary managerial behavior. Managers that are not controlled sufficiently act in self-interest. They build up cash from internal sources because this does not increase external discipline and can easily be used in their own interest.

The shareholder power hypothesis, which is analyzed by Harford et al. (2008) and Kuan et al. (2011), shares central characteristics with the pecking-order theory but does not consider a firm's entire capital structure. It stresses the avoidance of underinvestment as well as the influence of information asymmetries. The hypothesis regards a situation when shareholders are sufficiently protected from expropriation and discretionary managerial actions, for example by a strong legislation in favor of shareholders. Under such circumstances, shareholders allow increasing cash holdings because they do not fear exploitation by the management and acknowledge the benefits of avoiding costly external financing as well as underinvestment.

1.2 Existing empirical results

The empirical foundation of cash holding research is the seminal paper by Opler et al. (1999). They develop a model to explain the level of cash as a function of various firm characteristics which has become the standard in cash holding research. The model employs total assets as a proxy for firm size, the market-to-book ratio and R&D expenditures as proxies for growth opportunities, Capital expenditures as a measure of investments in fixed assets, total debt scaled by total assets as a proxy of firm leverage, cash flows scaled by total assets as a measure of profitability, net working capital as an estimate of liquidity substitutes, a dummy indicating dividend payments, and the standard deviation of cash flows as a proxy for financial risk, respectively financial distress. These variables or at least the determinants which they are supposed to represent have become the standard to include in cash holding models. Moreover, Opler et al. (1999) employ the percentage of insider ownership as an indicator for the quality of corporate governance. Proxies for governance quality have not

become a prerequisite for all cash holding studies but they are investigated frequently by many studies.

The determinants in the standard level of cash-model represent firm-level characteristics. However, research has also investigated the association of the level of cash with country-level characteristics. Exemplarily, Julio/Yook, 2012 show that firms increase their cash holdings in years of national political elections and simultaneously reduce corporate investments. Thus, this observation seems to be driven by a motive of precaution to guard a firm against political uncertainties. Chen et al., 2015 investigate the influence of a different country-level characteristic by focusing on the association between cash holdings and national culture. They find the cash level to decline and corporate investments to rise in countries with a more individualistic culture such as the United States. Vice versa, cash holdings rise and investments diminish with the degree of a country's uncertainty avoidance which is indicated by an index corresponding to Hofstede (2001).

As already mentioned, a shortcoming of existing research is that it either focuses on firm-level or country-level determinants but neglects the interaction between both types of cash holding determinants. Investigating this interaction effect addresses the question of how country-level characteristics influence the association between certain firm characteristics and the level of cash. Evidence on this question can only be derived implicitly by comparing firm-level results that are obtained from different countries. For example, Huang et al., 2013 show that US cross-listings increase the level of cash and this effect is more pronounced in firms from emerging markets. This suggests that corporate governance has a more positive association with the corporate cash level when the country-level of investor protection is low; respectively country-level information asymmetries are high.

Pinkowitz et al. (2016) choose a different approach to investigate international differences in cash holdings. They compare cash holdings in U.S. firms with the level of cash in foreign firms that have matching firm-level characteristics and do not find differences.

This either indicates the absence of an interaction effect between firm-level and regional characteristics or shows that regional characteristics have several interaction effects with different firm-level characteristics which overall offset each other.

In this sub-section, I provide a descriptive overview of existing results that provide implicit indications of interaction effects between regional- and firm-level determinants. I differentiate 10 determinants that are usually operationalized by different proxies and highlight indications of an interaction between regional and firm-level determinants of the cash level. I focus on the basic determinants mentioned before, which stem from Opler et al. (1999) and are most frequently applied in empirical research. I compute box plots of the determinant-elasticities of cash holdings by geographic regions. [4] The box contains the median elasticity and is restricted by the 25%- and 75%-quantile. The whiskers indicate minimum and maximum determinant-elasticities. This allows comparing the quartiles, dispersion, and skewness of determinant-elasticities across regions. The regional categories US, EU, and Asia embrace results that were derived from samples that are entirely restricted to one geographic region. The global category refers to results that were obtained from samples embracing various geographic regions. The determinant-elasticities are calculated from my meta-sample of primary studies and indicate the percental change of the cash level in reaction to a change of 1% in a specific determinant. This means a determinant-elasticity of 0.02 indicates that the level of cash changes by 2% when an individual determinant changes by 1%. The definition of the 10 determinant-elasticities can be found in section 2.3. Figure 1 reports the box plots and reveals that various elasticities differ depending on geographic regions. This indicates an interaction between firm-level determinants of cash and regional characteristics.

[4] The composition of the meta-sample is explained in Section 2.4, 2.5, and Appendix B. The calculation of the determinant-elasticities is explained more detailed in Section 2.3.

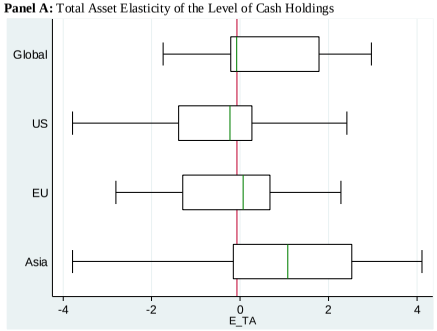
The box plots provide two initial observations: First, there appear to be large differences in the determinant-elasticities between geographic regions. This indicates that regional characteristics have an influence on how firm-level characteristics are associated with the level of cash. Second, even within one geographic region the determinant-elasticities exhibit a large range of values. This suggests that either the empirical design of studies or the properties of specific sub-samples within a region affect how a firm-level determinant drives the level of cash.

The box plots show that the median total asset-elasticity of cash is negative in US but positive in the EU and Asia. This is exemplarily confirmed by Ozkan/Ozkan (2004) for UK firms. The median elasticities in US and the EU are, unlike the elasticity in Asia, still close to each other. The investment activity-elasticity is negative across all regions. However, cash reacts more strongly in US, exhibiting a median elasticity close to -0.2, compared to all other regions. The US takes another distinct position when the R&D-elasticity of cash is regarded. European and Global studies report negative elasticities and object strongly to the positive results that are derived from US. A corresponding example from the literature are Bigelli/Sanchez-Vidal (2012) who point out that growth opportunities do not increase cash holdings in private Italian companies. Global and US results are reported to be negative but European and Asian results are positive. Exemplarily, a positive association between the level of cash and leverage is found in Chinese firms by Chen et al. (2012). As the box plots show, the elasticities have large outliers and especially observations from the Asian sample are split broadly between -1 and +1. The cash flow-elasticity of the cash ratio reports another switch of signs in elasticities. In this case, Global and Asian samples tabulate a positive median-elasticity but US and European results are negative.

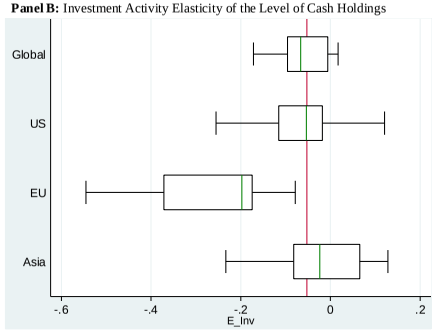
Figure 1: Box Plots of the Determinant-Elasticities of Cash Holdings by Regions

Figure 1 exhibits box plots of the determinant-elasticities of cash holdings split by geographic regions. Panel A-J show the determinant- elasticity of the level of corporate cash holdings for 10 distinct determinants. Geographic regions are defined in section 3.2 – explanatory variables. Red lines mark the overall median of a determinant-elasticity, green lines indicate the median within a geographic region. All variables are defined in Appendix A.

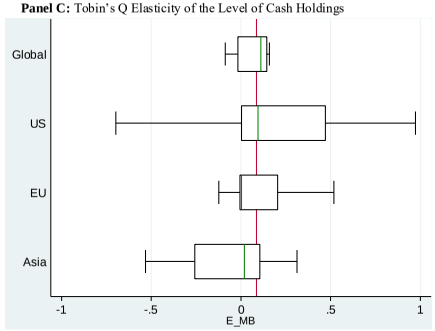
Panel A: Total Asset Elasticity of the Level of Cash Holdings



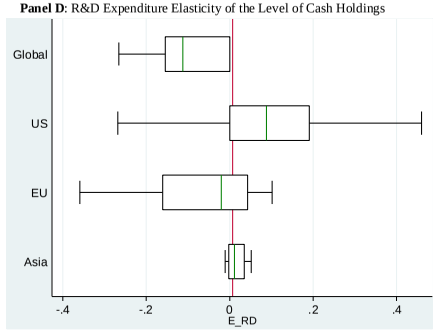
Panel B: Investment Activity Elasticity of the Level of Cash Holdings



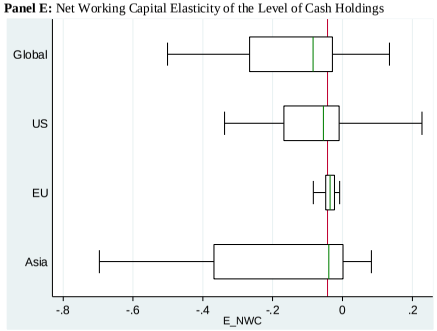
Panel C: Tobin's Q Elasticity of the Level of Cash Holdings



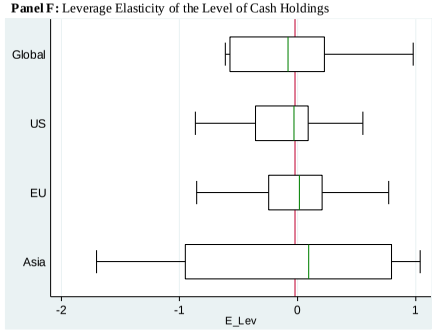
Panel D: R&D Expenditure Elasticity of the Level of Cash Holdings



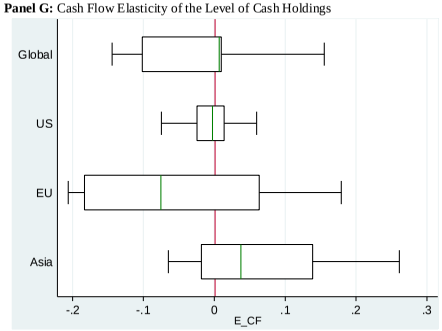
Panel E: Net Working Capital Elasticity of the Level of Cash Holdings



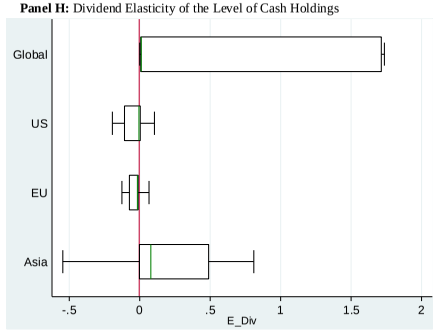
Panel F: Leverage Elasticity of the Level of Cash Holdings



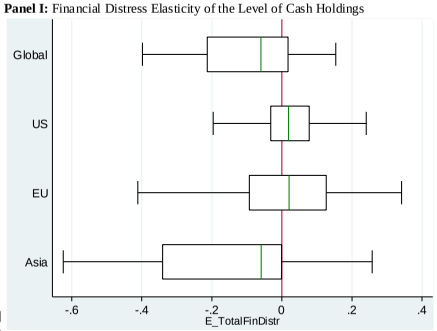
Panel G: Cash Flow Elasticity of the Level of Cash Holdings



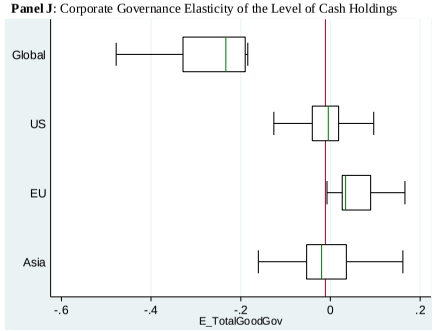
Panel H: Dividend Elasticity of the Level of Cash Holdings



Panel I: Financial Distress Elasticity of the Level of Cash Holdings



Panel J: Corporate Governance Elasticity of the Level of Cash Holdings



The same differences are confirmed for the financial distress- and the corporate governance-elasticity. This is especially interesting in case of the corporate governance-elasticity of cash holdings because a positive elasticity conflicts with predictions from the FCF-theory. Accordingly, declining information asymmetries that are caused by increases in the quality of corporate governance, decrease cash holdings in Global and Asian studies, but increase them in European and US studies. Specifically, Liu et al. (2015) find cash to increase with increasing board independence in China. A possible explanation is that country-level governance such as shareholder protection and legal enforcement is on average stronger in purely US and European samples compared to Asian and Global samples (La Porta et al., 1997 and Leuz et al., 2008). Thus, strongly protected shareholders might acknowledge a firm's need for cash to avoid costly external financing as suggested by the shareholder power hypothesis. Results that less dispersed across geographic regions are derived for the market-to-book-, net working capital- and dividend-elasticity.

In many cases determinant-elasticities appear to be more dispersed in Asia; the range of observed elasticity values in Asia embraces all observed value from other regions. This observation can be found for the total asset-, net working capital-, leverage-, financial distress-elasticity of cash holdings. The US shows by far the most dispersed elasticities when the market-to-book ratio and R&D expenditures are regarded. The global sample exhibits the most dispersed dividend-elasticities of cash. The dispersion of the remaining three determinant-elasticities is mostly similar.

2 Methodology

2.1 The approach of meta-regression analysis

Meta-regression analysis allows the quantitative aggregation of results from distinct primary studies that investigate the same research question (Stanley/Doucouliagos, 2012). This aggregation of results accounts for differences in the research design of the respective

primary studies and structures conflicting results (Feld et al., 2013). The systematic procedure of MRA allows deriving new insights regarding the influence of primary study characteristics (Stanley/Jarrell, 1989).

Empirical results on the determinants of cash holdings are diverse: Theoretical perspectives, variable definitions, econometric specifications, and the directions of estimated effects vary greatly which makes a comparison of results and the derivation of a holistic primary model a challenge. MRA is especially suited to resolve these issues by estimating the general effect of each of the most common cash holding determinants. It comprises existing cash holding studies into one meta-sample, consisting of various time periods, countries and firm characteristics. Moreover, the MRA approach pools existing results from different primary samples that were derived using different econometric methods and different variable definitions. Thus, meta-regressions identify the relation between the level of cash and specific determinants across modelling choices. This enables an estimation that is robust to the primary empirical modelling and allows predicting the impact of the study characteristics such as the geographic region.

Economic research already picked up the instrument of MRA to investigate contrary results in individual areas of research.[5] Examples include Égert/Halpern (2006) who study equilibrium exchange rates in new EU member states, Efendic et al. (2011) who analyze the effect of institutions on economic performance, Doucouliagos et al. (2014) who investigate the income elasticity of the value of a statistical life, i.e. the income elasticity of the marginal cost of avoiding deaths, and Zigraiova/Havranek (2015) who regard the impact of bank competition on financial stability. However, the MRA method is not widespread in the fields of business and finance, a scarce example is Feld et al. (2013) who analyze results regarding the effect of corporate taxes on capital structure.

[5] See Stanley/Doucouliagos (2012) for a general introduction into MRA and its areas of application.

MRA uses the association between one explanatory variable and the dependent variable found in primary studies as its dependent variable. Thus, MRA is the regression analysis of regression analyses. The economic association that serves as the dependent variable in a MRA is called "effect size" and can be estimated by various proxies like a regression coefficient, t-value or elasticity. The explanatory variables of a meta-regression describe the characteristics of the primary studies from which the effect sizes were derived. These characteristics include, amongst others, the econometric models used, the calculation of the dependent variable, the sample size, time period under analysis or the regional setting. Accordingly, a meta-regression model takes the following basic linear functional form,

$$Y_{it} = \beta_0 + \sum_{k=1}^{K} \beta_k \times Z_{ikt} + \varepsilon_{it}, \quad (1)$$

where Y_{it} is the effect size of study i in publication-year t. Z_{ikt} is a vector of k explanatory variables describing characteristics of the primary studies.

2.2 Publication Selection Bias

An important challenge of MRA is publication selection. This describes the selective reporting of results to increase a study's chance of being published. As Card/Krueger (1995) note, the main sources of publication selection are the intent of being compatible to the current conventions of the respective field of research and the preference of significant over insignificant results. Publication selection leads to results that are distorted towards current conventions and disregard insignificant results. This distortion is referred to as publication bias. There are numerous ways to account for this bias in MRAs. The funnel-asymmetry test (FAT) and the precision-effect test (PET), derived by Stanley/Doucouliagos (2007) and Stanley (2008), appear to be superior according to simulations undertaken by Stanley/Doucouliagos (2014) and Moreno et al. (2009). Their intuition, introduced by Egger et al. (1997), is that the standard errors associated with an effect size should vary

symmetrically around the most precise effect size and should be independent of the respective effect sizes. In the presence of publication selection, standard errors will vary asymmetrically, i.e., unprecise effect sizes will be distorted towards the conventional mainstream expectation and not symmetrically around the most precise estimates (Egger et al., 1997 and Stanley/Doucouliagos, 2014). The FAT-PET MRA accounts for this dependence and takes the following basic linear functional form:

$$Y_{it} = \beta_0 + \beta_1 \times ErrorTerm_{it} + \varepsilon_{it}. \quad (2)$$

$ErrorTerm_{it}$ is the standard error of the economic relation estimated in the respective primary study, which is used to calculate the effect size Y_{it}. If Y_{it} in eq. (2) is a regression coefficient from a primary study, $ErrorTerm$ equals the standard error of this regression coefficient reported in the respective primary study. In this univariate set-up β_0 indicates the economic association in the primary study if publication bias was absent. Thus, β_0 is also referred to as the precision-effect test (PET). When eq. (2) is applied on a sample of various studies, β_0, i.e. the PET, represents the consensus association of this sample. The coefficient of $ErrorTerm$, β_1 determines the magnitude as well as the sign of publication selection. It is called funnel-asymmetry test (FAT). Despite its simple construction, especially the PET has been proven to be "surprisingly effective in separating the wheat from the chaff" (Stanley, 2008).

2.3 Model design

I follow the approach of Stanley/Doucouliagos (2012) in designing this MRA. A first indication of the effects of distinct cash holding determinants is provided by a graphical analysis. I derive funnel plots for each effect size. Subsequently, the impact of publication bias is controlled for, in univariate FAT-PET models that correspond to eq. (2). These models derive estimates for the individual association between the level of cash and each of the ten determinants leading to a total of ten distinct FAT-PET models.

Finally, I employ multivariate MRAs to examine the effect of other study characteristics on the consensus associations and to reduce potential sources of endogeneity. Most importantly, this approach tests if the geographic regions influences the effect size, which equals an interaction effect between regional and firm-level effects. The individual multivariate MRAs are determined according to the general-to-specific approach recommended by Stanley/Doucouliagos (2012) and their econometric specification is determined according to Feld/Heckemeyer (2011). A general version of these multivariate MRAs with a control for publication selection, based on eq. (1), is depicted in eq. (3):

$$Y_{it} = \beta_0 + \beta_1 \times ErrorTerm_{it} + \sum_{k=2}^{K} \beta_k \times Z_{ikt} + \varepsilon_{it} \quad (3)$$

Corresponding to eq. (1), Y_{it} is the effect size of study i in publication-year t and Z_{ikt} represents a vector of k explanatory variables describing characteristics of the primary studies. Heteroscedasticity is a frequent problem of MRAs. It is accounted for by using a weighted least squares (WLS) estimator. These WLS-MRAs scale all explanatory variables by a the standard errors that are associated with each observation of Y_{it}. These standard errors need to be reported in the respective primary studies just like effect size.

I include all estimates of the effect size that can be found in a primary study in my meta-sample. This approach generates a larger sample of observations of effect sizes per determinant and avoids a selection bias resulting from choosing only one specific observation from each primary study. However, this method bears the risk of unobserved heterogeneity, resulting from study-level effects, that needs to be accounted for. This means that observations which are obtained from the same study might be affected by specific characteristics of this primary study that are not controlled for in my MRAs. I rely on fixed effects WLS estimators and standard errors clustered on the study-level to mitigate this dependence, as advised by Stanley/Doucouliagos (2012).

Dependent variable

Each of my models uses the effect size of an individual cash holding determinant as dependent variable, which leads to 10 distinct models. I chose the elasticity E_*_{it} as the measure of effect size Y_{it}. Elasticities are comparable across studies because they account for differences in the scaling of variables and they can be interpreted intuitively (Stanley/Doucouliagos, 2012). Exemplarily, when total assets are used to explain cash holdings in a regression model, the specification of the total assets-variable, either as the balance sheet value or its log, influences its regression coefficient. However, the total asset-elasticity of cash holdings remains unaffected by this modelling choice. It denotes the percental change of the level of cash when total assets change by 1%, i.e. a total asset-elasticity of 0.02 indicates that the level of cash changes by 2% when total assets change by 1%. The individual elasticities are calculated by the subsequent formula:

$$Y_{it} = E\_*_{it} = B\_* \times \frac{M\_*}{M\_CH} \quad (4)$$

In eq. (4), B_* is the regression coefficient of the respective cash holding determinant, taken from a primary study. In each of the ten models, the asterisk is replaced by the name of the respective cash holding determinant, as shown in Appendix A. Consequently, B_TA is the regression coefficient of total assets. M_CH denotes the mean value of cash holdings and M_* the mean value of the respective determinant in a primary study. Thus, M_TA is the mean of total assets of a primary study. The determinants under consideration are total assets (E_TA), investment activity (E_Inv), market-to-book ratio (E_MB), R&D expenditures (E_RD), net working capital (E_NWC), leverage (E_Lev), cash flow (E_CF), dividends (E_Div), financial distress ($E\_TotalFinDistr$) and corporate governance quality ($E\_TotalGoodGov$). The resulting elasticities are stated in parentheses. Each is used as the dependent variable in a distinct MRA and measured in accordance with eq. (4).

E_Inv comprises two proxies, capital expenditures and acquisition expenditures. When a primary model uses capital expenditures or acquisition expenditures, I calculate the capital expenditure-elasticity respectively the acquisition expenditure-elasticity of cash according to eq. (4) but denote it in either case as E_Inv.[6] I proceed in the same way for $E\_TotalFinDistr$, which consists of proxies such as Altman's Z-score, cash flow volatility or credit ratings as well as $E\_TotalGoodGov$, which consists of proxies such as managerial ownership, board independence or CEO duality. These distinct proxies are treated as observations of the same variable, $E\_TotalFinDistr$ respectively $E\_TotalGoodGov$. Proxies for financial distress and the quality of corporate governance are adjusted to guarantee that a high value of each proxy indicates a high probability of financial distress, respectively a high quality of corporate governance. This is achieved by multiplying the primary study regression coefficient of the respective proxy with -1 whenever high values of a proxy in a primary study indicate a low probability of financial distress, respectively a low quality of corporate governance. This is exemplarily the case for entrenchment indices as in Harford (2008). A high value for this variable indicates that CEOs are entrenched and protect themselves from external discipline, which is a sign for corporate governance of low quality.

This approach is difficult to undertake for proxies of ownership because of its potential non-linear influence on the level of cash according to Drobetz/Grüninger (2007). I disregard this non-linearity of ownership proxies and assume high values to indicate high quality corporate governance. First, there is no consensus on the non-linearity of ownership and the general influence of different ownership variables. Second, it is my goal to investigate the general influence of corporate governance and not the specific implications of ownership. Finally, ownership variables are just one set out of various proxies that constitute

[6] Therefore E_Inv_{it} can result from two equations: $E\_Inv_{it} = B\_Capx \times \frac{M\_Capx}{M\_CH}$ and $E\_Inv_{it} = B\_Acqu \times \frac{M\_Acqu}{M\_CH}$.

$E\_TotalGoodGov$, therefore a potential maladjustment of few ownership observations is absorbed by the unambiguous results of the remaining majority of governance variables.

Explanatory variables

The vector Z_{ikt} of the multivariate MRA in eq. (3) represents the characteristics of primary studies, these are mostly coded as dummies. Inspired by Égert/Halpern (2006), I include dummies for each type of empirical estimation approach considered in the primary study. There are six options: Either OLS without fixed effects (the reference category), OLS with industry-fixed effects only (OLS_IndFE_{it}), OLS with time-fixed effects only (OLS_TimeFE_{it}), OLS with time- and industry-fixed effects ($OLS\_IndTimeFE_{it}$), or either an instrumental variable approach or an difference-in-differences approach ($IVDiD_{it}$). These dummies take the value of 1 if the respective estimation approach was applied in a primary model and 0 otherwise.

Other explanatory variables are the log of the average sample year ($LogAvgSampleYear_{it}$), log of the number of observations ($LogObservations_{it}$), and dummies for the geographical region from which the primary study's sample stems. These regional dummies indicate whether the sample of a primary study focusses exclusively on US (the reference category), exclusively on Asia ($Asian\ sample_{it}$) or exclusively on Europe ($EU\ sample_{it}$). Whenever a primary study investigates firms from different regions jointly, e.g. Asian and European firms, and it is therefore impossible to identify a region-specific determinant-elasticity, the dummy $Global\ sample_{it}$ equals 1.

Another dummy indicates if a primary study's sample is restricted to firms that are especially subject to high firm-level information asymmetries ($HighInfoAsym_{it}$). Its purpose is to distinguish between country-level effects resulting from a country's characteristics and effects resulting from the presence of unique firms that do not exist in other countries. It takes the value of 1 when a primary study focusses exclusively on high-

tech, young, financially constrained, R&D-intensive, non-diversified, risky, badly-governed, small firms, firms with a high market-to-book ratio, firms with a non-investment credit rating, firms with a high standard deviation of cash flows, firms with entrenched managers, firms with CEOs that do not hold options of the respective firms, firms whose CEO compensation is highly sensitive to the stock price volatility (high vega),[7] or firms with a high product market fluidity, i.e. firms that face competitors who quickly adjust their product portfolio to match the products of the firm under analysis, otherwise it takes the value 0. Thus, I do not measure information asymmetries myself but rely on the measurement of primary studies that restrict their samples to firms with specific features indicating the presence of information asymmetries. Consequently, my dummy for information asymmetries is independent from individual problems of modelling information asymmetries. This also implies that I only regard information asymmetries resulting from firm characteristics and not from country characteristics like investor protection.

I also employ a set of dummies indicating the control variables used in a primary model. The dummies take the value of 1 if a determinant was used as a control variable in the respective primary study, otherwise 0. I use the following dummies to account for the use of control variables: Firm size ($Firmsize_{it}$), the market-to-book ratio (MB_{it}), R&D expenditures (RD_{it}), capital expenditures ($Capx_{it}$), net working capital (NWC_{it}), leverage (Lev_{it}), cash flow (CF_{it}), financial distress ($FinDistr_{it}$), and governance quality ($TotalGov_{it}$). Such control variable dummies are only included if the respective determinant is not the dependent variable of the MRA. Due to multicollinearity, the multivariate MRAs do not contain all of the dummies. However, exchanging the aforementioned dummies does not alter the regression results. The multivariate MRA takes the general form of eq. (5),

[7] High vega indicates a high incentive for managers to take risks (Liu/Mauer, 2011).

where * is replaced by the respective variable, i.e. E_TA is the total asset-elasticity of the cash level: [8]

$$E\_*_{it} = \beta_0 + \beta_1 \times ErrorTerm_{it} + \beta_2 \times OLS\_IndFE_{it} + \beta_3 \times OLS\_TimeFE_{it}$$
$$+\beta_4 \times OLS\_IndTimeFE_{it} + \beta_5 \times IVDiD_{it} + \beta_8 \times LogAvgSampleYear_{it}$$
$$+\beta_9 \times LogObservations_{it} + \beta_{10} \times Asian\ sample_{it} + \beta_{11} \times EU\ sample_{it}$$
$$+\beta_{12} \times Global\ sample_{it} + \beta_{13} \times HighInfoAsym_{it} + \beta_{14} \times Firmsize_{it}$$
$$+\beta_{15} \times Capx_{it} + \beta_{16} \times MB_{it} + \beta_{17} \times RD_{it} + \beta_{18} \times NWC_{it} + \beta_{19} \times Lev_{it} + \beta_{20} \times CF_{it}$$
$$+\beta_{21} \times Div_{it} + \beta_{22} \times FinDistr_{it} + \beta_{23} \times TotalGov_{it} + \varepsilon_{it} \quad (5)$$

Since there are 10 determinants under analysis, model (5) exists in 10 specifications, each with a different elasticity as dependent variable.

2.4 Sample construction

I identify relevant studies by a comprehensive literature research. First, all journals in the field of finance and accounting, ranked A+, A, or B, according to the journal ranking "Jourqual 2.1" of the German Academic Association for Business Research (VHB) as well as working papers from the NBER database are considered. These sources are searched for studies containing the term "cash holding" in their titles. Subsequently, the references of the studies found in the first scanning-routine are searched for additional studies related to cash holdings.

The initial, hand-collected, sample of regression coefficients, associated standard errors and other study characteristics embraces 61 studies. Since this meta-study focuses exclusively on the influence of the most frequent determinants on the level of cash, only observations using a measure of the cash level as their dependent variable are kept in the final sample. Thus, studies that use excess cash or the change in cash as dependent variables as well as

[8] All dependent and explanatory variables and their abbreviations are introduced in Appendix A.

studies that investigate the influence of cash holdings on firm value are dropped. Furthermore, I omit studies that do not report mean values of the cash holding variable and the explanatory variables because these values are necessary to calculate elasticities. I also do not include interaction terms from the primary studies in my sample because these would inflate the number of explanatory variables in the meta-regression excessively and encounter problems of multicollinearity. Consequently, the final sample contains 45 studies, which equals 3439 effect sizes (elasticity-observations). I winsorize all elasticities at 1% and 99%.

2.5 Descriptive statistics

Table 1 provides the descriptive statistics for all dependent and explanatory variables. Panel A depicts summary statistics for the determinant-elasticities of cash holdings. According to the median-value cash holdings are rather inelastic to cash flows, dividends and financial distress. These determinants exhibit elasticities of 0.001, -0.003, and approximately 0, which are the smallest median-values of all determinant-elasticities. In absolute terms, the market-to-book ratio and total assets are the determinants to which the cash level reacts most elastic (-0.074 and 0.087). However, in case of total assets this high median-value is tied to a standard deviation of 1.663, hinting a high variability in this elasticity.

Distinguishing the market-to-book ratio and R&D expenditures, instead of treating them as one proxy, seems reasonable since the respective median-elasticities of 0.087 and 0.007 differ substantially. Moreover, the investment activities-elasticity, reported with a median of -0.053, indicates that tangible and intangible investments are financed differently.

The median of the corporate governance-elasticity, -0.011, confirms the FCF-hypothesis, which assumes cash holdings to be the result of managerial discretion and thus to decrease with an increasing quality of governance. Furthermore, the elasticities of cash holdings to its potential substitutes, net working capital and leverage, are negative. Panel B reports summary statistics for all explanatory variables.

Table 1 Descriptive Statistics

Panel A - Overview of Elasticities

Elasticity of Determinant	Mean	Min.	25% Percentile	Median	75% Percentile	Max.	Std. Dev.	Obs.
E_TA	0.042	-3.785	-0.625	-0.074	0.691	6.911	1.663	390
E_Inv	-0.072	-0.661	-0.094	-0.053	0.008	0.307	0.159	301
E_MB	0.131	-0.805	-0.002	0.087	0.223	1.234	0.330	343
E_RD	0.026	-0.930	-0.046	0.007	0.131	0.460	0.180	236
E_NWC	-0.010	-0.725	-0.166	-0.043	-0.009	0.282	1.869	319
E_Lev	-0.188	-3.884	-0.372	-0.021	0.174	1.038	0.800	410
E_CF	-0.009	-0.522	-0.031	0.001	0.027	0.267	0.110	364
E_Div	0.120	-0.546	-0.038	-0.003	0.260	2.852	0.538	243
E_TotalFinDistr	-0.044	-1.776	-0.089	0.000	0.059	0.743	0.266	536
E_TotalGoodGov	-0.014	-1.789	-0.052	-0.011	0.035	0.763	0.267	297
Total								3439

Panel B - Overview of Study Characteristics

	Mean	Min.	25% Percentile	Median	75% Percentile	Max.	Std. Dev.	Obs.
ErrorTerm	0.311	0.000	0.006	0.030	0.114	19.030	1.130	3439
CHtoTA	0.573	0	0	1	1	1	0.495	3439
OnlyIndustry_FE	0.067	0	0	0	0	1	0.250	3439
OnlyTime_FE	0.130	0	0	0	0	1	0.336	3439
Industry&Time_FE	0.268	0	0	0	1	1	0.443	3439
IVorDiD	0.140	0	0	0	0	1	0.347	3439
AvgSampleYear	1997.5	1979	1994	1998.5	2002	2008.5	6.677	3439
Observations	19438.87	7	2180	5100	13864	209036	34647.6	3206
HighInfoAsym	0.121	0	0	0	0	1	0.326	3439
Firmsize	0.966	0	1	1	1	1	0.182	3439
M/B	0.942	0	1	1	1	1	0.233	3439
R&D	0.740	0	0	1	1	1	0.439	3439
NWC	0.845	0	1	1	1	1	0.362	3439
Lev	0.926	0	1	1	1	1	0.263	3439
CF	0.883	0	1	1	1	1	0.321	3439
CFuncer	0.834	0	1	1	1	1	0.372	3439
FinDistr	0.074	0	0	0	0	1	0.262	3439
TotalGov	0.605	0	0	1	1	1	0.489	3439
Infl	0.104	0	0	0	0	1	0.305	3439

The variables tabulated in table 1 are defined in Appendix A.

Table 2 reports the number of observations of each determinant-elasticity split by geographic regions. The total sample comprises 3439 observations. Half of the observations stem from studies that focus exclusively on US. The other half is split evenly between Asian,

European and global studies. Australia is not used as a distinct geographic region because of the small number of observations. Consequently, results from Australia are not considered in the multivariate MRAs analyzing the effects of geographic regions on determinant-elasticities. However, results from Australia are kept for the univariate MRAs that derive consensus associations to include as many results as possible.

Table 2 Regional Sample Characteristics

Region	Observations										Total
	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_TotalFinDistr	E_TotalGoodGov	
Asia	55	59	48	36	59	63	66	62	95	129	672
EU	81	9	52	25	30	92	28	40	54	25	436
Global	69	43	32	40	59	59	55	13	84	8	462
Australia	4	4	4	0	4	4	12	0	8	0	40
US	181	186	207	135	167	192	203	128	295	135	1829
Total	390	301	343	236	319	410	364	243	536	297	3439

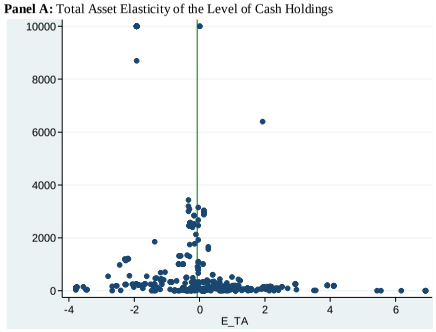
The variables tabulated in table 2 are defined in Appendix A.

Figure 2 depicts the funnel plot of each determinant-elasticity. Funnel plots visualize the idea of testing for publication selection by investigating the distribution of elasticities with respect to their standard errors. The y-axis represents the precision of an elasticity, which equals the inverse of the standard error. This means that high values on the y-axis indicate high precision. The x-axis represents the value of determinant-elasticities. The distribution of elasticities should ideally mirror a funnel that is centered on the most precise estimates, i.e. imprecise elasticities deviate from more precise estimates but the direction of deviation is random. Thus, Unprecise estimates should vary symmetrically around the most precise estimate. Deviations from the symmetrical funnel indicate the presence of publication bias that leads to skewed results (Egger et al., 1997). This means that results are engineered towards a perceived conventional true elasticity that is expected to increase the chance of publication which makes the direction of the elasticity's deviation depend on its precision.

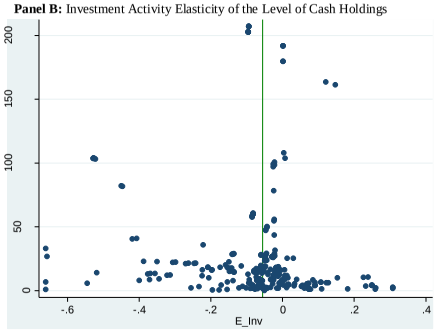
Figure 2 Funnel Plots of Determinant-Elasticities of Cash Holdings

Figure 2 exhibits the determinant-elasticities of cash holdings and their respective precisions in funnel plots. Precision is defined as the inverse of the standard error associated to a specific elasticity observation. Each of the panels A-J illustrates the funnel characteristics of a different determinant. The y-axis, i.e. the precision (1/SE), is restricted not to exceed 10000 (0.0001), respectively 1000 (0.001). This is done when extremely high precisions distort the scaling of the y-axis. The green line marks the median. All variables are defined in Appendix A.

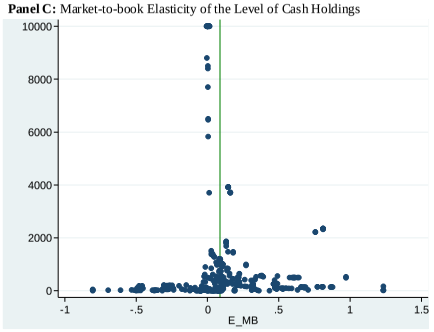
Panel A: Total Asset Elasticity of the Level of Cash Holdings



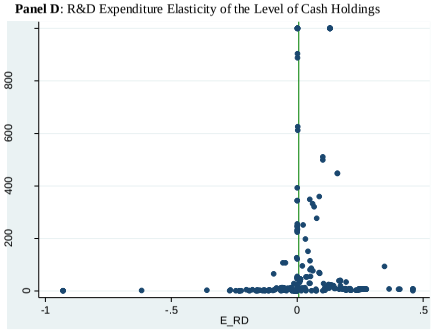
Panel B: Investment Activity Elasticity of the Level of Cash Holdings



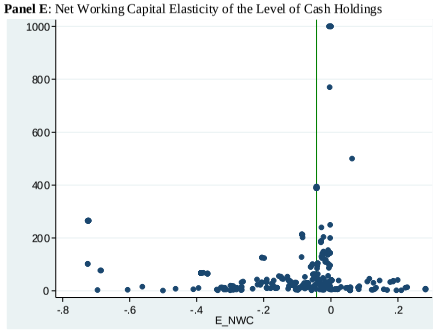
Panel C: Market-to-book Elasticity of the Level of Cash Holdings



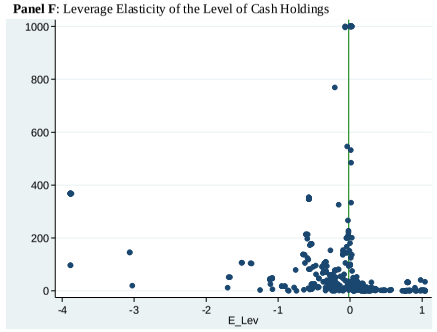
Panel D: R&D Expenditure Elasticity of the Level of Cash Holdings



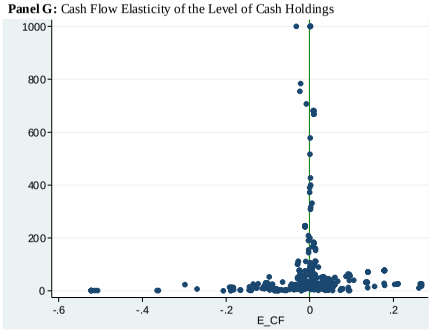
Panel E: Net Working Capital Elasticity of the Level of Cash Holdings



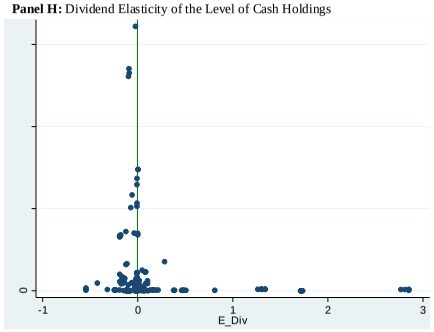
Panel F: Leverage Elasticity of the Level of Cash Holdings



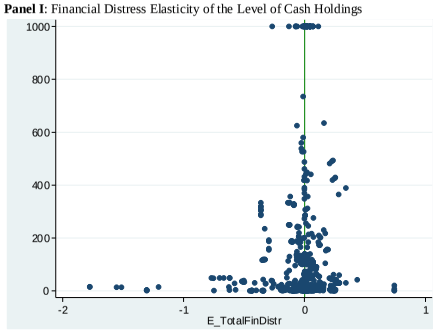
Panel G: Cash Flow Elasticity of the Level of Cash Holdings



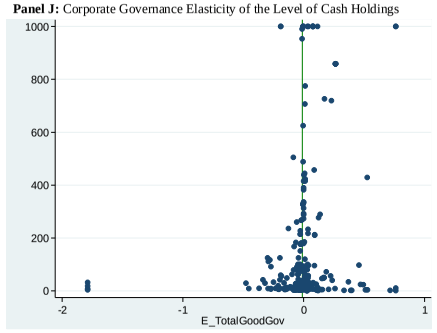
Panel H: Dividend Elasticity of the Level of Cash Holdings



Panel I: Financial Distress Elasticity of the Level of Cash Holdings



Panel J: Corporate Governance Elasticity of the Level of Cash Holdings



Highly precise elasticities that deviate from the funnel represent leverage points (Stanley/Doucouliagos, 2012). Such leverage points suggest situations when the general influence of a determinant on the cash level changes. Thus, they are not unprecise outliers but rather indicate that the determinant-elasticity of cash strongly deviates as a reaction to an influencing factor. The funnel plots complement many of the observations from the summary statistics and suggest the differences in individual determinant-elasticities by various leverage points.

The plots of the total asset-elasticity and of the net working capital-elasticity of cash holdings exhibit great outliers, as already indicated by their standard deviation. The outliers are in general quite large across all plots. While the median elasticities are, in absolute terms, all smaller than 0.1, the extreme values often exceed 1. Thus, the utilization of WLS estimator appears reasonable to account for these outliers.

All plots roughly resemble the shape of funnels. However, in all cases the distribution of elasticities with respect to their precision is skewed. This can especially be seen in the plots of net-working capital-elasticity, leverage-elasticity, cash flow-elasticity and dividend-elasticity of cash. Thus, publication selection is in general present but it remains impossible to determine its effect on the overall trend. Furthermore, many plots exhibit leverage points indicating meaningful deviation from the general trends. Examples include the total assets-elasticity, investment activity-elasticity, R&D expenditure-elasticity, financial distress-elasticity and corporate governance-elasticity of cash holdings.

3 Results

3.1 Consensus Determinant-Elasticities of Cash Holdings

Table 3 reports the consensus associations between each determinant and the level of cash resulting from univariate MRAs. In this table and subsequent tables, β_0 is the PET which indicates the consensus association, i.e. the elasticity, between an individual

determinant and the level of cash. The FAT, which indicates how publication bias affects the consensus elasticity, is represented by β_1. Each column represents a different MRA-model analyzing the association between an individual determinant and the level of cash.

Table 3 Univariate FAT-PET MRA

This table presents results from the basic univariate FAT-PET regressions. Panel A uses WLS-regressions and heteroscedasticity-robust standard errors. Panel B uses fixed effects WLS-regressions, clustered at the study level and standard errors which are also clustered at the study level. Finally, Panel C uses random effects WLS-regressions and standard errors modified as suggested by Knapp/Hartung (2003). All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

Panel A - FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Intercept: $\hat{\beta}_1$ (**FAT**)	895.7***	-0.514*	108.9***	10.03***	-8.403***	-45.02***	0.656***	3.340*	-9.545**	55.38**
	(7.50)	(-2.13)	(6.75)	(3.71)	(-5.29)	(-5.04)	(3.59)	(2.01)	(-2.71)	(2.63)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.916***	-0.0885***	0.000677	0.000986***	-0.00592	-0.0127	-0.00106	-0.0644***	0.0324***	0.0398***
	(-143.71)	(-4.49)	(1.11)	(5.85)	(-1.25)	(-0.74)	(-0.46)	(-4.82)	(5.71)	(4.26)
Adj. R-sq	0.081	-0.000	0.112	0.049	0.062	0.041	0.021	0.009	0.002	-0.000
Panel B - Fixed Effects FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	206.8	-1.444	2.401	0.443	-0.620	-2.443	1.338	4.605	-1.948	114.6
	(0.76)	(-2.05)	(0.27)	(1.10)	(-1.26)	(-0.71)	(1.18)	(1.37)	(-0.17)	(0.93)
1/SE: $\hat{\beta}_0$ (**PET**)	-1.902***	-0.0796***	0.00215***	0.00123***	-0.0110***	-0.0347***	-0.00204	-0.0655***	0.0320***	0.0395***
	(-352.52)	(-11.70)	(17.75)	(119.48)	(-34.45)	(-19.41)	(-1.26)	(-23.47)	(59.15)	(70.56)
Adj. R-sq	0.807	0.933	0.966	0.995	0.990	0.996	0.676	0.609	0.753	-0.057
Panel C - Random Effects FAT-PET WLS										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Intercept: $\hat{\beta}_1$ (**FAT**)	0.450**	0.427***	-0.213	0.0673	0.253	0.594***	-0.264*	0.424	-0.115	-0.173
	(2.61)	(3.42)	(-1.32)	(0.67)	(1.41)	(4.14)	(-2.50)	(1.92)	(-1.17)	(-0.85)
1/SE: $\hat{\beta}_0$ (**PET**)	-0.0662	-0.129***	0.151***	0.0549***	-0.118***	-0.334***	0.0247***	0.0753*	-0.0254*	-0.0105
	(-0.81)	(-9.66)	(7.75)	(7.36)	(-8.81)	(-7.53)	(4.51)	(2.06)	(-2.08)	(-0.59)
Adj. R-sq	0.017	0.032	0.005	0.007	0.007	0.044	-0.002	0.014	0.002	0.006
# observations	390	302	343	236	319	410	364	243	536	297
# studies	38	27	36	21	34	39	33	25	38	21

Panel A tabulates WLS-MRA models with heteroscedasticity-robust standard errors, panel B reports fixed effects WLS-MRAs with standard errors clustered at the study-level, and panel C exhibits the results of random effects WLS-MRA models with standard errors modified as suggested by Knapp/Hartung (2003). The Hausman test reveals that correlated unobserved heterogeneity affects all univariate models. Moreover, the underlying approach of collecting all results from reported in each primary studies indicates the risk of unobserved heterogeneity resulting from study-level dependencies as pointed out in section 2.3. Thus, the fixed effects models (panel B) derive the most robust results. Overall, cash holdings increase when the market-to-book ratio, R&D expenditures, financial distress, and the quality of

corporate governance increase. The corporate level of cash declines when total assets, investments expenditures, net working capital, leverage, and dividends diminish.

The determinant-elasticities are mostly robust across all econometric specifications. According to panel A, the market-to-book ratio (model 3), net working capital (model 5) and leverage (model 6) do not have a significant influence on the corporate cash reserves. However, all these determinants turn out to influence the level of cash after controlling for the study-level dependence of results in panel B and C. Dividends (model 8), financial distress (model 9) and corporate governance (model 10) are reported to affect the level of cash in panel A and B but the sign of the association switches, respectively the association becomes insignificant, in the random effects model in panel C. All determinants, except cash flow, impact the cash level in the fixed effects models in panel B.

3.2 Differences in the Determinant-Elasticities of Cash Holdings

The consensus determinant-elasticities presented in table 3 are estimated across the entire sample of studies and do not account for differences in the individual study design. In the next step of the analysis, I explore explanatory drivers of the determinant-elasticities and focus especially on the existence of an interaction between regional and firm-level determinants of cash holdings. Table 4 tabulates the corresponding results from fixed-effects multivariate MRAs. In these models, the constant cannot easily be interpreted as the elasticity after controlling for heterogeneity. It is difficult to derive statements on the general determinant-elasticity and its significance that are comparable to the univariate results in table 3. Thus, I focus on the influence of the individual primary study design, geographic regions, and high information asymmetries on the determinant-elasticities.

Overall, results indicate regional differences in the impact of individual cash determinants. However, the differences are less pronounced than existing research suggests. They are only found between US, Asia and the global sample. There is no indication of

differences in determinant-elasticities between US and Europe. Specifically, the results suggest that differences in Asia are the result of country-level agency issues or a lack of financing alternatives. This means that Asian legal regulations are less effective in protecting investors than their international counterparts and Asian firms do not rely on the capital market, especially equity investors. Overall, this points to a greater relevance of the FCF-hypothesis and the underinvestment problem in Asia, whereas trade-off of considerations and a more balanced financing hierarchy are prevalent in US and Europe.

I observe regional differences that do not stem from firm-level information asymmetries for six determinants. US differs from Asia as well as the global sample regarding the total asset-, market-to-book-, net working capital- and leverage-elasticity of the cash level. Asia is the only region that features an investment-elasticity that differs from US while the global sample is the only region that exhibits a cash flow-elasticity that is distinct from US.

The total asset- and investment-elasticity increases in Asia compared to US. This suggests that Asian firms do, in comparison to US firms, not tend to diversify their sources of financing when they grow in size. Instead, they hoard even more cash and are not forced by external discipline to constrain their cash reserves. The more negative leverage-elasticity in Asia indicates that debt providers are more efficient than the legal regime in enforcing external discipline or offer the only financing alternative. The association of the Asian dummy with the net working capital-elasticity suggests that Asian firms tend to transform cash into other liquid assets more frequently than US firms. This might be motivated by the intent to hide large liquidity reserves and the potential for discretionary managerial actions. The regional differences observed between US and the global sample do mostly not match the differences between US and Asia. The influence of the global sample is difficult to interpret because the composition of the countries analyzed in individual primary samples contained in the global sample cannot be taken into account. Thus, I regard the differences

resulting from the global sample as a general indication of regional differences but refrain from deducing their cause on basis of the results shown in table 4.

High firm-level information asymmetries increase the dividend- and corporate governance-elasticity and decrease the R&D-elasticity of cash holdings. This suggests that firms with high information asymmetries tend to hold more cash than their counterparts with low information asymmetries when they pay out dividends or when their corporate governance quality increases. According to the FCF-hypothesis, the level of cash should decline when the information asymmetries decline and the interests between shareholders and managers are aligned. High quality of corporate governance implies such an alignment of interests and dividend payments also serve as a signal of alignment. Against this background the mentioned effect of high information asymmetries indicates that increasing the alignment of interests is more effective in reducing the corporate cash stock when information asymmetries are already low. Firms with high information are reported to hold less cash when they increase R&D expenditures. This suggests a higher dependence of such firms on cash as an instrument to finance R&D projects. The corporate cash stock and operating cash flows are depleted to undertake R&D investments.

Finally, table 4 provides implications for the design of primary research. In most cases, determinant-elasticities do not depend on the econometric method applied. The total asset-, dividend-, financial distress-, and corporate governance-elasticity of cash holdings are an exception. The total asset- and financial distress-elasticity of cash increase when fixed effects, instrumental variables, or a difference-in-differences approach are employed instead of simple OLS regressions. The dividend- and corporate governance-elasticity decline when industry and time fixed effects, instrumental variables, or a difference-in-differences approach are used. Thus, the association between these four determinants and the level of cash might especially suffer from endogeneity and researchers need to be careful when investigating them for causal inferences.

Table 4 Explaining the Determinant-Elasticities of Cash Holdings

This table presents results from multivariate FAT-PET MRAs. Table 4 uses WLS-regressions with study fixed effects and standard errors clustered at the study-level. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Publication selection										
ErrorTerm	-43.21	-1.305	4.301	0.314	-0.792	-4.245	2.804	7.041	-6.303	108.2
	(-1.14)	(-1.94)	(0.36)	(0.79)	(-0.95)	(-1.14)	(1.42)	(1.40)	(-1.28)	(0.92)
Model characteristics										
OLS_IndFE	-0.0558	0.0309	-0.0163	-0.00187	0.00420	0.00572	-0.00471	-0.272*	-0.0329***	
	(-1.38)	(0.09)	(-0.28)	(-0.09)	(0.07)	(0.02)	(-0.54)	(-2.16)	(-618.23)	
OLS_TimeFE	-0.247	0.0940	0.000388	0.00531	0.0333	0.218	-0.00316	-0.0305***	0.106***	
	(-1.30)	(1.76)	(0.20)	(1.87)	(1.04)	(1.54)	(-0.41)	(-42.16)	(19.68)	
OLS_IndTimeFE	-0.236	0.102	0.00110	0.00492	0.0331	0.218	-0.00305	-0.0453***	0.0835***	-0.167***
	(-1.21)	(1.79)	(0.37)	(1.73)	(1.03)	(1.54)	(-0.40)	(-27.48)	(28.89)	(-31.10)
IVorDiD	0.806***	0.0383	-0.00178	-0.00570	0.0124	0.281	0.0107	-0.0225***	-0.000911	-0.266*
	(3.85)	(1.13)	(-1.69)	(-0.74)	(0.66)	(1.72)	(0.47)	(-7.10)	(-0.51)	(-2.29)
Sample characteristics										
LogAvgSampleYear	-205.0*	79.41*	-32.77		1.884	11.91	17.85	18.57	-40.92	
	(-2.17)	(2.73)	(-0.41)		(0.11)	(0.11)	(0.27)	(0.64)	(-0.15)	
LogObservations	0.0318	-0.0111	0.00717	-0.00232	-0.0161	-0.125	0.00385	0.00871	0.00337***	0.0487***
	(1.28)	(-1.84)	(1.05)	(-1.73)	(-1.05)	(-1.76)	(0.96)	(0.58)	(60.72)	(901.98)
Asian sample	1.030***	0.300***	0.291***	-0.495	-0.0833***	-0.970***	-0.342	-0.00812	5.826	
	(12.39)	(5.19)	(3.63)	(-0.72)	(-6.52)	(-15.51)	(-1.34)	(-0.57)	(1.34)	
EU sample	0.484	0.0356	-0.332	-0.386	0.0518	0.223	-2.207	-0.736	20.33	
	(0.48)	(0.15)	(-0.42)	(-0.71)	(0.42)	(0.22)	(-1.37)	(-1.61)	(1.26)	
Global sample	0.449***	0.0161	-0.0533***	0.00146	0.144***	0.113***	-0.00858**		-0.00405	
	(21.17)	(1.72)	(-15.35)	(1.54)	(18.96)	(4.03)	(-2.81)		(-0.25)	
HighInfoAsym	0.141	-0.00934	-0.0385	-0.0159***	0.0194	-0.0429	0.0104	0.142***	-0.0258	0.0320***
	(1.02)	(-0.33)	(-0.97)	(-8.19)	(0.73)	(-0.40)	(0.49)	(6.59)	(-0.58)	(174.69)
Moderating variables of primary study										
Firmsize					-0.0174***		-0.00466			
					(-4.09)		(-0.77)			
Capx			-0.000805***	-0.0000256	-0.000366	0.0129	0.0369***			
			(-8.24)	(-1.73)	(-0.09)	(0.26)	(5.99)			
MB				-0.00333	0.0248***	0.584	0.0127			-1.540
				(-0.02)	(4.93)	(0.67)	(1.24)			(-0.96)
NWC			-0.0690				0.467		-0.464***	
			(-0.22)				(1.52)		(-7.50)	
Lev		0.103***			-0.00378		-0.0364***			
		(18.05)			(-0.93)		(-5.91)			
CF									0.645***	
									(9.30)	
Div									-0.0145	
									(-0.46)	
FinDistr			4.329			-9.399	-3.910	-3.630		
			(0.36)			(-1.17)	(-1.47)	(-1.39)		
TotalGov	2.268***	-0.00639	0.0189	-0.00186*	-0.00742	-0.118	-0.400	0.00384	0.00252*	
	(6.30)	(-1.90)	(0.87)	(-2.46)	(-1.13)	(-1.11)	(-1.35)	(0.55)	(2.31)	
Constant	1554.9*	-603.6*	249.2	0.0255	-14.19	-82.10	-135.9	-140.3	310.3	1.533
	(2.17)	(-2.73)	(0.41)	(0.19)	(-0.10)	(-0.10)	(-0.27)	(-0.63)	(0.15)	(0.89)
Database Dummies	No	No	No	No	No	No	No	No	No	No
Study Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Observations	366	258	319	216	295	386	300	223	507	297
# Sudies	36	25	34	20	32	37	31	24	36	21
Adj. R-sq	0.920	0.961	0.971	0.996	0.994	0.997	0.710	0.672	0.964	0.261

Table 5 provides further insights on the effects of the empirical research design by including additional variables that model the design of primary research. A dummy for the specification of the cash holding variable is included. It takes the value 0 if cash holdings are calculated as cash plus short-term investments scaled by net assets (the reference category)[9] and 1 if cash holdings are defined as cash scaled by total assets ($CHtoTA_{it}$). I also include a dummy that takes the value 1 if a determinant was in the central focus of the respective primary study ($VarCentral_{it}$). The underlying intuition is that determinants which are in the central focus of a study are potentially subject to more publication bias than the control variables of the same study. A determinant is assumed to be in the central focus if it is mentioned in the abstract, the introduction or the conclusion of a study. Finally, I also add the variable $Datastream$ and $OtherDataB$. They take the value 1 when the accounting information of a primary study do not stem from Compustat but from Datastream, respectively a different source of data. Both variables take the value 0 If the accounting information are obtained from Compustat.

The inclusion of these study characteristics results in losing the difference of the Asian region for the total asset-, market-to-book-, net working capital-, and leverage-elasticity of cash holdings. In contrast, the cash flow- and dividend-elasticity of cash holding rises, respectively declines, when Asia is compared to the US. This observation is most likely related to the addition of the database indicators. Studies that deviate from a standard US sample are more likely to employ databases distinct from Compustat. These studies either rely on Datastream because it offers a more extensive coverage of international firms or they use a national, potentially hand-collected database. Thus, changing a study's database does not necessarily cause a change of results but the change of results is rather related to the geographic region of a study's sample which determines the required database.

[9] Net assets equal total assets less cash.

Table 5 Determinant Elasticities of Cash Holdings and the Empirical Design of Research

This table presents results from multivariate Fat-Pet MRAs using WLS-regressions and standard errors clustered at the study-level. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

	(1) E_TA	(2) E_Inv	(3) E_M/B	(4) E_R&D	(5) E_NWC	(6) E_Lev	(7) E_CF	(8) E_Div	(9) E_Total FinDistr	(10) E_Total GoodGov
Publication selection										
ErrorTerm	-3.170	-0.406	-8.810	0.683	1.962	-6.070	0.610	3.517	-1.344	76.63
	(-0.12)	(-0.59)	(-0.82)	(1.11)	(1.03)	(-0.94)	(0.93)	(1.12)	(-0.48)	(0.88)
Model characteristics										
OLS_IndFE	0.132	0.979*	-0.241*	-0.281**	-0.229	2.559*	-0.00423	-0.135	-0.0328***	-0.929*
	(0.49)	(2.57)	(-2.45)	(-3.43)	(-0.51)	(2.29)	(-0.53)	(-1.29)	(-247.39)	(-2.16)
OLS_TimeFE	-0.158	-0.0589	0.000341	-0.0364	0.0960*	-0.0864	-0.00495	-0.0336***	0.00592	0.514***
	(-0.91)	(-0.60)	(0.16)	(-0.99)	(2.38)	(-0.13)	(-0.69)	(-9.16)	(0.13)	(4.87)
OLS_IndTimeFE	-0.344*	-0.0160	-0.000252	-0.0368	0.0993*	0.617*	-0.00490	-0.0387***	0.0638***	-0.166***
	(-2.36)	(-0.22)	(-0.07)	(-1.00)	(2.31)	(2.06)	(-0.68)	(-4.57)	(3.64)	(-10.41)
IVorDiD	-0.0831	0.0170	-0.00134	0.00348	0.168	0.704	0.0290	-0.0223***	-0.0122	-0.222**
	(-0.41)	(0.29)	(-0.60)	(0.37)	(1.90)	(1.10)	(1.10)	(-9.34)	(-0.92)	(-2.87)
CHtoTA	0.0682	0.275**	0.0353	-0.0187	-0.0833	-0.388	0.000127	-0.144*	0.00473	0.326
	(0.16)	(3.16)	(0.35)	(-0.77)	(-0.66)	(-0.98)	(0.01)	(-2.67)	(0.33)	(0.83)
VarCentral	-0.661***	0.642**	0.279	-0.00331	-0.724	0.607	0.00298	-0.0712	0.0670	5.486
	(-4.55)	(2.94)	(2.00)	(-0.19)	(-2.01)	(1.77)	(0.27)	(-1.39)	(0.78)	(1.29)
Datastream	1.736**	-0.0918	-0.367**	-0.191**	0.252	1.940*	-0.0195	0.349*	-0.000732	-4.315
	(3.43)	(-0.73)	(-3.16)	(-3.12)	(0.77)	(2.21)	(-0.80)	(2.39)	(-0.01)	(-0.79)
OtherDataB	-0.557**	-0.830*	-0.274	1.230	0.285	-0.195	0.0320**	0.370**	-0.00480	-0.0101
	(-3.45)	(-2.40)	(-1.81)	(1.12)	(1.59)	(-0.26)	(2.96)	(3.30)	(-0.05)	(-0.02)
Sample characteristics										
LogAvgSampleYear	-175.9***	121.0***	29.84	-15.83**	12.33	146.5	-7.259	-20.13	-24.49***	-57.86
	(-4.29)	(4.39)	(0.78)	(-3.87)	(0.86)	(1.20)	(-1.87)	(-1.75)	(-6.35)	(-0.87)
LogObservations	0.0414*	-0.00394	0.0159	0.0174	-0.0473*	-0.303*	0.00383	-0.00882	0.00325***	0.0487***
	(2.17)	(-0.52)	(1.12)	(1.00)	(-2.26)	(-2.10)	(1.05)	(-1.02)	(19.10)	(880.77)
Asian sample	2.091	1.140**	-0.131	-1.320	-0.0411	1.568	0.0732**	-0.241*	-0.0775	-0.283
	(1.87)	(2.90)	(-0.90)	(-1.20)	(-0.27)	(1.65)	(2.91)	(-2.07)	(-0.84)	(-0.60)
EU sample	-2.115***	-0.154	0.0675	0.159**	0.0619	-2.067*	-0.0754	-0.235	0.269**	4.152
	(-4.47)	(-0.42)	(0.41)	(3.31)	(0.11)	(-2.65)	(-1.56)	(-1.70)	(3.12)	(0.81)
Global sample	0.149	0.615**	-0.0385	0.0222	0.341	3.207**	-0.00934*	-0.216	0.0344	3.417
	(0.89)	(3.64)	(-1.23)	(0.93)	(2.03)	(3.23)	(-2.10)	(-1.91)	(0.48)	(0.70)
HighInfoAsym	0.128	-0.308	-0.382*	0.00255	0.326	0.812	0.0116	0.106*	0.0655	0.0319***
	(0.72)	(-2.02)	(-2.09)	(0.19)	(1.59)	(1.30)	(0.80)	(2.26)	(1.16)	(219.04)
Moderating variables of primary study										
firmsize		-0.659***	-0.540***			1.070**	0.0807*	0.149***		5.354
		(-3.88)	(-4.39)			(2.96)	(2.61)	(4.36)		(1.25)
MB		-1.492***	1.005**	0.0871	0.331	3.737***	0.0575***			0.315
		(-4.77)	(3.14)	(0.49)	(0.91)	(3.74)	(7.07)			(1.19)
RD		1.498***	-0.445*							1.362
		(5.13)	(-2.71)							(0.69)
Capx		0.124***	0.343**	0.153***	-0.250	0.925	-0.0352*		0.0832	-1.384
		(6.26)	(3.15)	(8.39)	(-1.32)	(1.84)	(-2.65)		(1.74)	(-0.83)
NWC		0.204	-0.154				0.0822**		0.0643	
		(0.73)	(-0.99)				(3.12)		(1.37)	
Lev			-0.343**	-0.153***	0.241		0.0360*			0.559
			(-3.15)	(-8.39)	(1.27)		(2.72)			(0.46)
CF		-0.416***	0.154							-0.100
		(-4.96)	(0.68)							(-0.73)
Div										-0.404
										(-0.57)
FinDistr		-0.659***	-0.540***			1.070**	0.0807*	0.149***		5.354
		(-3.88)	(-4.39)			(2.96)	(2.61)	(4.36)		(1.25)
TotalGov	0.694***	-0.825***	0.384	0.162***	-0.668***	-3.129***	-0.00274	-0.0473	0.00224*	-1.053
	(5.05)	(-11.07)	(1.71)	(12.45)	(-6.47)	(-3.85)	(-0.25)	(-1.18)	(2.46)	(-0.62)
Constant	1335.5***	-919.3***	-227.4	120.1**	-93.91	-1114.6	55.03	153.1	185.9***	434.4
	(4.29)	(-4.39)	(-0.78)	(3.86)	(-0.86)	(-1.20)	(1.87)	(1.75)	(6.35)	(0.86)
Database Dummies included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Study Fixed Effects	No	No	No	No	No	No	No	No	No	No
# Observations	366	258	319	216	295	386	300	223	507	297
# Sudies	36	25	34	20	32	37	31	24	36	21
Adj. R-sq	0.797	0.922	0.927	0.941	0.862	0.871	0.646	0.597	0.957	0.268

Most determinant-elasticities are robust to the definition of the cash holding variable. The only exception are the investment- and dividend-elasticity of cash holdings which increase, respectively decrease, when cash is scaled by total assets instead of net assets. Equivalently, most determinant-elasticities are robust to the focus of interest of a primary study. This means that determinant-elasticities do not change when the respective determinant is of central interest for the underlying study. The only exception are the total assets- and investment-elasticity which decline/increase when total assets/investments are in the central focus.

Overall, this shows that the association between individual explanatory variables and the level of cash is quite robust to empirical design choices. Choosing between simple OLS regression, the inclusion of different types of fixed effects, and using instrumental variable or a difference-in-differences approach appears to be the most influential design choice. It affects the total asset-, dividend-, financial distress-, and corporate governance-elasticity of cash holdings, at least. Table 5 also reports the investment-, market-to-book-, R&D-, net working capital-, and leverage-elasticity to be affected but these are rather infrequent observations.

3.3 Country Characteristics and the Determinant-Elasticities of Cash Holdings

So far, this study points out how the empirical design in level of cash regressions affects individual results and provides evidence for the existence of an interaction effect between firm-level and regional drivers of cash holdings. Exploring the cause of these regional differences in the association between firm-level characteristics and the level of cash is outside of the scope of this study. Meta-regressions have the purpose of estimating general trends in research results and analyzing the effects of the design of primary studies.

Subsequently, I try to explore the driver of the regional differences by modelling the characteristics of individual countries. This requires me to focus only on elasticities that are

derived from studies that analyze single countries. There are several studies that investigate the U.S. individually, but very few studies focus exclusively on one Asian or European country. I only regard the characteristics of countries that are investigated by at least two single-country studies. Consequently, I focus on single-country studies in China, Japan, Switzerland, the UK, and the US.

I determine the following country characteristics: GNI scaled by the number of inhabitants (GNI/cap) and the change in the capitalization of the capital market ($MarketCapGrowth$), which is defined as the change in market capitalization of listed domestic firms scaled by the GDP. Both variables are obtained from The World Bank World Development Indicators database. Moreover, the Polity2 index of democracy ($Democracy$) converted from a -10 to +10 scale to a 0-1 scale which is obtained from Gennaioli et al. (2014), and the sum of a countries exports and imports scaled by its DGP ($Openness$) obtained from Gennaioli et al. (2014) are included. GNI/cap is a common indicator for the economic development of a country as it is the central measure for the to differentiate developed countries from developing countries used by the World Bank. $MarketCapGrowth$ suggests the size and relevance of the equity market. $Democracy$ measures how democratic the political system of a country is. 0 represents a total autocracy and 1 equals a total democracy. Finally, $Openness$ indicates if a country is well connected with other countries, which is beneficial because the transfer of technologies as well as labor is fostered and the economy grows.

Moreover, dummy variables are included, indicating the decades over which the primary studies' samples span. I employ five time dummies ($60s$, $70s$, $80s$, $90s$ and $2000s$,). They equal 1 if at least one year of the respective decade is covered by the sample period of a primary study; otherwise 0. This provides insights about time trends of individual consensus associations. The 60s are used as the reference category. Thus the individual time dummies indicate how a switch from a sample period spanning over the 60s to one that spans, for

example, over the 80s impacts the consensus associations. The time dummy for the 90s is dropped because there is too little variation, as the 90s are covered by all studies.

I apply the multivariate model presented in table 4 on the sub-sample of single-country studies and add the previously discussed country characteristics. The value of the respective country characteristics are assigned based on the average sample year of the sample from which an elasticity is derived. This means, if an elasticity is derived from a U.S. sample and the average sample year is 1990, consequently GNI/cap takes the value associated with the year 1990 and $MarketCapGrowth$ is equal to the growth in market capitalization from 1989 to 1990. The results are presented in table 6, the control variables from table 4 are included but not tabulated.

Results show that most regional differences are not explained by differences in the economic condition of a country or the relevance of the equity market. The total asset-, investment activity-, net working capital-, and leverage-elasticity of cash are unaffected by the additional control variables. Regional differences in the market-to-book-elasticity of cash holdings disappear after including the country characteristics and time dummies, although these variables do not have a significant impact. The inclusion of the decade dummies does not reveal a clear time trend. In most cases the dummies do not affect determinant-elasticities. The net working capital- and cash flow-elasticity of cash are the only associations that are affected by various decade dummies. However, sign associated with the dummies switches and does not document a persistent time trend.

Table 6 Determinant-Elasticities of Cash Holdings and Country Characteristics

This table presents results from multivariate FAT-PET MRAs using a sample consisting only of studies foucssing on single countries. Table 6 uses WLS-regressions with study fixed effects and standard errors clustered at the study-level. Models 1-10 include the same control variables as the corresponding models in table 4. For the sake of brevity, these control variables are not tabulated. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

FAT-PET WLS-FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Asian sample	1.936***	0.273**	-0.153	-1.769	-0.155***	-2.285*	-0.281	-0.819	3.750	
	(8.84)	(3.63)	(-0.27)	(-0.91)	(-24.41)	(-2.42)	(-1.32)	(-0.53)	(0.97)	
EU sample	4.604**	-0.458*		2.918		-5.739			17.10	5.857
	(2.99)	(-2.64)		(0.97)		(-0.73)			(0.96)	(1.03)
70s	3.369*	0.00842	0.682	1.839	-0.184***	-1.191***	-0.161*	0.175	-26.09	
	(2.38)	(0.04)	(1.39)	(0.92)	(-10.25)	(-6.77)	(-2.12)	(0.69)	(-0.96)	
80s	-30.42	-0.00468	1.153	-0.671	0.106***	0.177	0.314***	1.131	19.00	8.948
	(-1.04)	(-0.07)	(0.54)	(-0.93)	(17.88)	(0.08)	(4.30)	(0.70)	(0.94)	(1.09)
90s	42.51	0.341	-10.68	2.388	-1.449***	-2.316***	1.291	-2.481	-2.844	-3.847
	(1.37)	(1.16)	(-0.83)	(0.97)	(-7.94)	(-4.23)	(1.80)	(-0.71)	(-0.91)	(-1.19)
2000s	28.26	0.103	-1.805	0.912	-0.144***	0.698	-0.289**	-1.056	-16.99	
	(0.97)	(1.41)	(-0.66)	(0.88)	(-14.11)	(0.23)	(-3.22)	(-0.67)	(-0.94)	
GNI/cap	0.000462***	0.0000110*	-0.0000125	-0.0000873	-0.00000124	-0.000271*	-0.0000374	0.00000142	-0.000556	0.000110
	(12.49)	(2.49)	(-1.01)	(-1.00)	(-1.22)	(-2.26)	(-1.43)	(0.16)	(-0.97)	(1.03)
MarketCapGrowth	0.0538***	0.00690	0.0562	0.00419	-0.000925	-0.0417	-0.000564	0.00167	-0.153	2.585
	(7.71)	(1.50)	(1.07)	(1.15)	(-0.73)	(-1.88)	(-0.17)	(1.55)	(-1.05)	(1.15)
Democracy	34.35**	-0.0163	0.0657		1.511***	-26.57**	0.0278	-0.560	1.520	-0.271
	(2.84)	(-1.86)	(0.87)		(8.19)	(-3.34)	(2.06)	(-0.21)	(0.97)	(-0.77)
Openess	13.38***	0.234	10.13	-4.981	0.0234	4.651	1.738**	-0.118		
	(6.85)	(0.87)	(0.70)	(-0.97)	(0.36)	(0.26)	(3.57)	(-0.33)		
HighInfoAsymmetry	0.195	-0.0144	-0.0260	-0.00473	0.0292	-0.0298	0.0161	0.155***	0.0128	0.0320***
	(1.34)	(-0.44)	(-0.61)	(-0.81)	(1.29)	(-0.24)	(1.59)	(54.69)	(0.64)	(138.54)
Constant	-55.79***	-0.277*	-2325.3	1.327	0.142**	-2529.0	-657.3*	2.621	26.60	-0.226
	(-5.00)	(-2.14)	(-0.76)	(1.06)	(3.29)	(-0.59)	(-2.67)	(0.68)	(0.92)	(-0.29)
Controls	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.
Database Dummies	No	No	No	No	No	No	No	No	No	No
Study Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Observations	261	180	263	151	193	283	201	174	371	226
# Studies	27	18	29	17	23	28	23	19	28	16
Adj. R-sq	0.920	0.956	0.971	0.998	0.999	0.998	0.854	0.640	0.967	0.258

In the next step, I extend the analysis by including the dummy variable $CivLaw$ which takes the value of 1 if a country‘s legal system originates from a civil law tradition. In case of a common law origin the variable takes the value 0. The classification of legal tradition is obtained from La Porta et al. (2000). This variable could not be included in the models of table 6 because it would have been absorbed by the study fixed effects. Therefore, table 7 employs WLS regressions without study fixed effects. The tabulated results reveal that the differences in determinant-elasticities in Asia diminishes with the inclusion of $CivLaw$. The leverage-elasticity of cash holdings is found to be the only association that persists to differ between the US and Asia.

This indicates that the regional differences in the association of firm-level characteristics with the level of cash mainly results from diverging legal traditions. A common law tradition is assumed to be associated with a high country-level of investor protection; vice versa civil law countries feature a low level of investor protection, as La Porta et al. (2000) point out. This implies that country-level investor protection is largely responsible for regional differences in the influence of firm-level cash holding determinants. China as well as Japan and Switzerland follow a civil law tradition while the UK and the US follow a common law tradition. Thus, the effect of the legal origin is difficult to distinguish from the general regional differences between Asia and the US that was found before. Consequently, the insights from table 7 should not be interpreted as strong evidence but rather as a call for additional research that is able to clearly distinguish the effect a country's legal tradition on the association between firm-level characteristics and the level of cash. I am unable to include more country characteristics, for example the corporate tax rate, or the level of investor protection because my sample features either too few observations or too little variation. Moreover, I need to partly sacrifice the strength of MRA, namely its broad sample and independence of individual modelling choices, to undertake this analysis of country characteristics.

It is a goal for future research, to provide more insights on the regional differences in the impact of firm characteristics on cash holdings. The interaction of firm and country characteristics stills needs to be investigated more thoroughly from a causal viewpoint. This requires a more extensive investigation of various country characteristics in a broad international sample and especially the inclusion of a potential interaction effect between firm-level cash determinants and regional characteristics.

Table 7 Determinant-Elasticities of Cash Holdings and Legal Origin

This table presents results from multivariate FAT-PET MRAs using a sample consisting only of studies foucssing on single countries. Table 7 uses WLS-regressions and standard errors clustered at the study-level. Models 1-10 include the same control variables as the corresponding models in table 4. For the sake of brevity, these control variables are not tabulated. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

FAT-PET WLS-FE										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent Variable:	E_TA	E_Inv	E_MB	E_RD	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Asian sample	-48.51		0.259	6.362	0.278	-5.593*	1.243	0.421	-8.187	25.76
	(-1.65)		(0.25)	(1.67)	(0.80)	(-2.20)	(1.60)	(0.54)	(-1.28)	(0.90)
EU sample	-2.081**	-0.241	-1.911	-11.33	0.634	5.640*	-0.522*	1.160***	-0.923	-3.668
	(-2.78)	(-0.75)	(-1.66)	(-1.70)	(0.66)	(2.13)	(-2.28)	(5.44)	(-0.23)	(-0.89)
70s	-0.214	0.332**	-1.124	-0.438	1.034**	2.377	-0.239	0.408	0.0586	
	(-0.42)	(2.96)	(-1.71)	(-0.71)	(3.42)	(1.51)	(-1.56)	(1.70)	(0.15)	
80s	-0.201	-0.509***	-0.132	0.0127	-0.388**	0.294	0.0866**	0.231*	-0.137	8.466
	(-0.90)	(-17.35)	(-0.86)	(0.27)	(-2.97)	(0.53)	(3.35)	(2.36)	(-1.62)	(1.03)
90s	0.688*	-0.0631	-0.165	-0.706*	0.160	-3.339***	-0.109*	-0.0185	-0.0102	-1.173
	(2.30)	(-1.03)	(-0.69)	(-2.64)	(1.76)	(-3.80)	(-2.36)	(-0.16)	(-0.06)	(-1.73)
2000s	0.0881	0.662***	0.249	0.391	0.0731	-0.380	-0.00112	-0.222**	0.288	-0.407
	(0.28)	(11.31)	(1.60)	(1.88)	(0.28)	(-0.66)	(-0.02)	(-3.16)	(1.92)	(-0.12)
CivLaw	48.99	0.421*	-0.163	-7.255*		6.789*	-1.370	-0.541	7.114	-37.77
	(1.66)	(2.47)	(-0.14)	(-2.34)		(2.55)	(-1.56)	(-0.76)	(1.33)	(-0.98)
GNI/cap	0.000000135	0.00000200	0.0000256***	0.0000133	-0.0000240***	-0.000142***	0.00000341	-0.0000120***	-0.00000234	-0.000268
	(0.01)	(0.54)	(4.58)	(1.99)	(-5.31)	(-5.92)	(0.97)	(-9.09)	(-0.30)	(-0.96)
MarketCapGrowth	-0.102*	0.00216	0.444	0.0272	-0.0313	0.326*	-0.0210	0.0233	-0.252	-1.528
	(-2.33)	(0.20)	(0.96)	(0.30)	(-0.85)	(2.09)	(-1.28)	(1.30)	(-1.25)	(-0.45)
Democracy	0.0733*	-0.00389	-0.0276**	-52.78	0.0250	0.194***	0.00682*	0.00276	-0.00814	-0.722
	(2.43)	(-0.57)	(-3.01)	(-0.82)	(1.99)	(6.37)	(2.39)	(0.31)	(-0.94)	(-0.91)
Openess	6.037*	-0.712	5.256	30.79	-3.692	-19.93*	0.802	0.0457	2.970	
	(2.37)	(-1.41)	(1.32)	(1.87)	(-1.34)	(-2.14)	(1.14)	(0.03)	(0.22)	
HighInfoAsymmetry	-0.0554	-0.0257	-0.0353	-0.00963	-0.208	0.437	0.0158	0.146***	0.000137	0.0320***
	(-0.21)	(-0.97)	(-0.76)	(-1.47)	(-1.37)	(1.27)	(1.93)	(13.67)	(0.01)	(138.54)
Constant	2190.5*	77.65	1693.8*	2677.3*	-1062.1*	-4863.6*	267.3	-709.8***	426.3	4.246
	(2.57)	(0.42)	(2.63)	(2.40)	(-2.22)	(-2.57)	(1.10)	(-4.11)	(0.52)	(0.74)
Controls	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.
Database Dummies	No	No	No	No	No	No	No	No	No	No
Study Fixed Effects	No	No	No	No	No	No	No	No	No	No
# Observations	261	180	263	151	193	283	201	174	371	226
# Studies	27	18	29	17	23	28	23	19	28	16
Adj. R-sq	0.913	0.956	0.951	0.990	0.971	0.974	0.821	0.635	0.967	0.258

3.4 Robustness & limitations

I conduct two sets of robustness checks for the multivariate analysis. Firstly, I alter the control for publication selection by exchanging the estimate's standard error with the squared standard error. The PET estimator then becomes the so-called precision-effect estimate with standard error (PEESE) estimator. According to Stanley/Doucouliagos (2007 and 2014) and Moreno et al. (2009), this estimator provides an improved correction for publication selection, when there actually is a publication bias. However, the FAT-PET model is more precise when there is no publication selection. The corresponding results are documented in table 8. Secondly, I vary the effect size by using the t-values of the primary regression coefficients instead of its elasticities. T-values are, like elasticities, robust to differences in

scaling across estimates but are not as easy to interpret from an economic viewpoint. The results of this test are tabulated in table 9.

Table 8 Robustness Control - PEESE estimation

This table presents results from multivariate PEESE MRAs using WLS-regressions with study-level fixed effects and standard errors clustered at the study-level. The dependent variables are the determinant-elasticities of cash holdings. Table 8 replicates table 4 but uses the squared error term associated with the determinant-elasticities to control for publication selection. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

	(1) E_TA	(2) E_Inv	(3) E_M/B	(4) E_R&D	(5) E_NWC	(6) E_Lev	(7) E_CF	(8) E_Div	(9) E_Total FinDistr	(10) E_Total GoodGov
Publication selection										
ErrorTerm_squared	0.00790	-0.213	-0.000531	-0.0608	-0.601	-0.0281	0.149	0.724	0.00252	-0.449
	(0.40)	(-0.92)	(-0.05)	(-1.17)	(-0.79)	(-0.46)	(0.85)	(0.82)	(0.09)	(-0.91)
Model characteristics										
OLS_IndFE	-0.0498	-0.474	-0.0149	0.0160***	0.00453	0.00208	-0.00372	-0.153	-0.0330***	
	(-1.32)	(-2.06)	(-0.25)	(9.36)	(0.08)	(0.01)	(-0.46)	(-1.65)	(-1410.13)	
OLS_TimeFE	-0.241	0.100	0.000439	0.00583	0.0303	0.212	-0.00777	-0.0300***	0.109***	
	(-1.30)	(1.50)	(0.23)	(2.06)	(1.02)	(1.51)	(-0.91)	(-61.62)	(28.94)	
OLS_IndTimeFE	-0.231	0.108	0.00115	0.00543	0.0300	0.212	-0.00762	-0.0452***	0.0859***	-0.166***
	(-1.20)	(1.51)	(0.39)	(1.92)	(1.01)	(1.51)	(-0.89)	(-32.57)	(47.74)	(-38.70)
IVorDiD	0.808***	0.00330	-0.00183	-0.00595	0.0101	0.257	0.0237	-0.0178***	-0.000684	-0.159***
	(4.02)	(0.08)	(-1.74)	(-0.76)	(0.57)	(1.71)	(1.66)	(-11.80)	(-0.41)	(-26.59)
Sample characteristics										
LogAvgSampleYear	-190.9*	91.73*	-32.34		0.269	11.11	0.457	19.23	-9.174	
	(-2.61)	(2.47)	(-0.39)		(0.02)	(0.10)	(0.04)	(0.84)	(-0.07)	
LogObservations	0.0355	-0.0102	0.00688	-0.00256	-0.0145	-0.119	0.00390	-0.000727	0.00342***	0.0488***
	(1.32)	(-1.41)	(0.98)	(-1.92)	(-1.02)	(-1.71)	(0.99)	(-0.06)	(99.89)	(680.51)
Asian sample	0.950***	0.198***	0.291**	0.270	-0.0777***	-1.027***	0.0223**	0.00421	0.190**	
	(33.08)	(10.28)	(3.54)	(1.45)	(-9.40)	(-13.38)	(2.99)	(0.22)	(2.92)	
EU sample	-0.402	-0.340*	-0.115	0.170	-0.0819	-0.878	-0.0336	-0.0813	-0.157	
	(-1.26)	(-2.38)	(-0.42)	(1.56)	(-1.00)	(-1.50)	(-0.33)	(-0.72)	(-0.28)	
Global sample	0.463***	0.00780	-0.0532***	0.00175	0.145***	0.118***	-0.00674**		-0.0243***	
	(33.49)	(0.85)	(-15.01)	(1.93)	(17.19)	(3.96)	(-3.17)		(-39.19)	
HighInfoAsym	0.100	-0.0650**	-0.0344	-0.0162***	0.0123	-0.0181	0.0330*	0.145***	-0.0312	0.0318***
	(0.77)	(-3.03)	(-0.91)	(-9.42)	(0.44)	(-0.20)	(2.18)	(11.99)	(-0.67)	(635.65)
Moderating variables of primary study										
firmsize					-0.0187***		-0.00455			
					(-3.74)		(-1.03)			
MB				-0.00592	0.0247***	-0.400***	0.0228***			-0.0696
				(-0.04)	(4.82)	(-7.55)	(5.10)			(-1.26)
Capx			-0.000815***	-0.0000283	-0.00316	-0.0441***	0.0405***			
			(-8.50)	(-1.92)	(-0.63)	(-3.59)	(9.18)			
NWC			-0.172**				0.0136		-0.385***	
			(-3.27)				(0.52)		(-47.70)	
Lev		0.104***			-0.00127		-0.0399***			
		(17.88)			(-0.26)		(-9.10)			
CF									0.559***	
									(29.16)	
Div									-0.00788	
									(-0.47)	
FinDistr			0.0754			-0.342	-0.911	-0.421		
			(0.50)			(-0.82)	(-1.01)	(-0.79)		
TotalGov	2.314***	-0.00514	0.0201	-0.00215**	-0.00782	-0.117	-0.135*	0.000894	0.00254*	
	(6.86)	(-1.37)	(0.91)	(-3.08)	(-1.12)	(-1.09)	(-2.65)	(0.15)	(2.38)	
Constant	1447.7*	-697.1*	246.0	0.0303	-1.934	-82.20	-3.499	-146.1	69.27	-0.0441
	(2.60)	(-2.47)	(0.39)	(0.21)	(-0.02)	(-0.10)	(-0.04)	(-0.84)	(0.07)	(-0.79)
Database Dummies included?	No	No	No	No	No	No	No	No	No	No
Study Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Observations	366	258	319	216	295	386	300	223	507	297
# Sudies	36	25	34	20	32	37	31	24	36	21
Adj. R-sq	0.918	0.957	0.971	0.996	0.994	0.997	0.650	0.659	0.963	0.256

Table 9 Robustness Control - T-value of Cash Holding Determinants

This table presents results from multivariate Fat-Pet MRAs using WLS-regressions with study-level fixed effects and standard errors clustered at the study-level. Table 9 replicates table 4 but uses the t-values associated with the determinant-elasticities of cash holdings as dependent variables. All variables are defined in Appendix A. ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels. The t-statistics are shown in parantheses.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable - T-value associated with:	E_TA	E_Inv	E_M/B	E_R&D	E_NWC	E_Lev	E_CF	E_Div	E_Total FinDistr	E_Total GoodGov
Publication selection										
ErrorTerm	735.1	-175.0	-489.9	-122.4	539.3*	174.4	485.4*	14.09	-202.6	861.9
	(1.06)	(-1.16)	(-0.61)	(-0.84)	(2.12)	(1.45)	(2.34)	(0.27)	(-0.51)	(0.95)
Model characteristics										
OLS_IndFE	1.328	108.8	-9.711***	9.935	48.48	11.95***	0.308	3.773	-2.825***	
	(0.98)	(1.61)	(-20.66)	(1.30)	(1.97)	(5.03)	(0.53)	(0.92)	(-634.06)	
OLS_TimeFE	-11.30	15.71	0.923***	-12.74***	3.556	12.75	9.637***	-1.681***	6.078*	
	(-1.21)	(1.92)	(5.09)	(-11.80)	(0.50)	(1.05)	(13.89)	(-20.49)	(2.32)	
OLS_IndTimeFE	-9.573	18.51*	0.777***	-13.81***	1.892	12.04	10.68***	-2.255***	2.450***	-6.619
	(-1.10)	(2.12)	(5.14)	(-12.79)	(0.26)	(0.99)	(15.42)	(-22.15)	(12.17)	(-2.06)
IVorDiD	-3.737	6.703	-0.970***	1.237	-2.908	5.672	5.964**	1.531***	0.128*	-6.050
	(-0.77)	(1.02)	(-12.68)	(1.77)	(-0.75)	(0.82)	(3.60)	(10.89)	(2.44)	(-1.54)
Sample characteristics										
LogAvgSampleYear	2525.2	-7316.4*	4260.8***		-16169.8*	-13726.4***	-4310.8***	-1992.3*	-5217.5	
	(1.94)	(-2.37)	(6.62)		(-2.28)	(-12.99)	(-4.21)	(-2.27)	(-1.37)	
LogObservations	-0.972	-2.332*	6.528***	9.375***	-4.812	-15.93*	3.434***	-1.622	0.471***	2.720***
	(-1.02)	(-2.27)	(25.90)	(18.41)	(-1.41)	(-2.55)	(12.41)	(-1.19)	(100.14)	(782.44)
Asian sample	-4.212*	-6.323	18.66***	221.8	-15.45	45.41***	-64.90*	2.870	167.5	
	(-2.44)	(-0.46)	(11.47)	(0.88)	(-1.64)	(4.05)	(-2.38)	(0.99)	(0.47)	
EU sample	2.093	58.31	14.46	188.6	-63.30	20.67	-367.2*	1.337	662.5	
	(0.13)	(1.26)	(0.35)	(0.95)	(-1.22)	(0.43)	(-2.18)	(0.18)	(0.51)	
Global sample	9.609***	0.582	7.703***	-0.477	-0.175	-3.652	-6.501***		6.242***	
	(18.50)	(0.41)	(61.53)	(-1.36)	(-0.13)	(-1.29)	(-30.03)		(4.90)	
HighInfoAsym	9.794**	2.015	-1.372	2.604	-6.241	-6.870	6.488**	4.272***	1.477	2.780***
	(3.34)	(0.30)	(-0.56)	(1.09)	(-1.48)	(-1.38)	(3.24)	(3.97)	(1.27)	(801.49)
Moderating variables of primary study										
firmsize					12.82***		-6.665***			
					(11.30)		(-16.13)			
MB					-13.64***	-39.25	6.092***			-10.84
					(-12.68)	(-1.40)	(7.11)			(-0.88)
Capx			-0.528***	0.00613	-10.07***	-2.988	2.604***			-18.69
			(-94.90)	(1.09)	(-7.06)	(-1.54)	(5.32)			(-1.45)
NWC			-35.82				44.61		-15.08**	
			(-1.87)				(1.32)		(-3.09)	
Lev		42.63***			-12.70***		4.065***			
		(35.86)			(-9.43)		(8.27)			
CF									34.04***	
									(6.13)	
Div									-0.902	
									(-1.07)	
FinDistr			-486.8			382.2	-638.6*	-13.20		
			(-0.61)			(1.44)	(-2.29)	(-0.46)		
TotalGov	-11.93*	-1.326*	3.647***	4.331***	-3.211	-7.259	-10.89	-0.251	0.350*	
	(-2.56)	(-2.38)	(11.84)	(15.66)	(-1.99)	(-1.75)	(-0.57)	(-0.36)	(2.39)	
Constant	-19169.0	55528.8*	-32405.0***	-79.37	122891.1*	104123.3***	32679.6***	15153.7*	39601.6	1.370
	(-1.94)	(2.37)	(-6.62)	(.)	(2.28)	(13.02)	(4.19)	(2.27)	(1.37)	(0.10)
Database Dummies included?	No	No	No	No	No	No	No	No	No	No
Study Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Observations	366	258	319	216	295	386	300	223	507	297
# Sudies	36	25	34	20	32	37	31	24	36	21
Adj. R-sq	0.962	0.872	0.807	0.998	0.984	0.991	0.975	0.854	0.911	0.644

The results from my previous analyses are confirmed by both robustness checks. The fixed effects PEESE model in table 8 stresses the difference between the Asian and Global samples on the one side and the US sample on the other side even stronger. They also confirm significant regional differences for the cash flow- and financial distress-elasticity. The multivariate fixed effects WLS using the t-values in table 9 roughly confirms the results of its counterpart which uses elasticities. However, it derives less pronounced results as many of the regional differences found in Asia are either lost or switch their signs. Results for Europe and the global sample remain more consistent with prior results.

4 Conclusion

This article investigates the existence of an interaction effect between regional and firm-level characteristics in determining the corporate level of cash. Existing research documents the direct influence of regional and firm-level characteristics but remains silent on their interaction. By documenting the interaction effect this study points out that regional characteristics influence the level of cash by altering the association between various firm-level characteristics and the level of cash. This indirect influence of regional characteristics needs to be investigated by future research to fully understand why and how regional characteristics such as investor protection influence cash holdings.

Moreover, this study provides evidence on how the empirical design of cash holding studies influences their results, i.e. the association of cash holding determinants with the level of cash. These insights serve as guidance for future research and point out the most critical design decisions as well as the areas which are most likely to be influenced by these decisions. The influence of total assets, dividends, and corporate governance depends on whether a standard OLS regression is applied or instrumental variables, respectively a difference-in-differences approach. The association of net working capital, leverage, and financial distress with cash holdings is affected by the inclusion of industry and time fixed

effects. The choice of the underlying database has either no influence or its effect cannot be distinguished from country-level characteristics. The definition of the cash holding variables does also not affect the outcome of empirical research.

In the first step, this study derives general statements regarding the determinants of the corporate cash level, which are not bound to specific situations, time periods, sample characteristics, the econometric modelling of primary studies or variable definitions. These so-called consensus estimates are obtained by aggregating the quantitative results from primary research in a meta-regression analysis. In the second step, I investigate regional differences in these consensus estimates which are equivalent to an interaction effect between regional and firm-level characteristics. This part of the analysis also investigates how the design of primary studies affects the respective results of primary research. In the last step, I test whether these regional differences are explained by specific country-level characteristics such as a country's development, the size of equity markets, or legal tradition.

I analyze the influence of 10 determinants on the level of cash, respectively the determinant-elasticity of cash. In summary, cash holdings decrease when total assets, investment activities, net working capital, leverage, cash flow, and dividends increase. Moreover, the corporate cash ratio rises when the market-to-book ratio, R&D expenditures, financial distress, and the quality of corporate governance declines.

Graphical analyses and multivariate MRAs reveal regional differences in the influence of firm-level cash holding determinants. Determinant-elasticities are shown to be comparable in US and the EU but differ between US and Asia as well as the Global sample. The influence of firm-level determinants on the level of cash in Asia appears to be affected by the country-level of governance quality or a lack of financing alternatives. This suggests a greater relevance of the FCF-hypothesis and the underinvestment problem in Asia in comparison to Europe and the U.S. These regional effects are robust to controlling for the presence of

specific firm types that feature high information asymmetries, the economic situation of a country, the liquidity of a country's capital market, and the national legal tradition.

5 Appendix

Appendix A Variable Description

Variable	Description
Data-variants of cash holding determinants *- always combined with one of the suffixes below*	
B_*	Regression coefficient of the respective determinant in the primary study.
E_*	Determinant-elasticity of cash holdings. The determinant is specified by the suffix that replaced the asterisk
M_*	Mean value of the respective determinant in the primary study.
Cash holding determinants - always combined with one of the prefixes above	
*CF	Cash flow
*CFuncer	Cash flow uncertainity
*CH	Cash holdings
*Div	Dividends
*Inv	Investment expenditures
*Lev	Leverage
*MB	Market-to-book ratio
*NWC	Net working capital
*RD	Research & development expenditures
*TA	Total assets
*TotalGoodGov	Total good corporate governance
*TotalFinDistr	Total financial distress
Explanatory variables	
Asian sample	Dummy variable that takes the value 1 if a primary regression analysis considered exclusively Asian firms and 0 otherwise.
CHtoTA	Dummy variable that takes the value 1 if cash holdings were calculated as cash scaled by total assets, in the respective primary regression model, and 0 otherwise.
ErrorTerm	Standard error of a determinant's regression coefficient, taken from primary studies
EU sample	Dummy variable that takes the value 1 if a primary regression analysis considered exlusviely firms that are geographically located in Europe and 0 otherwise.
Global sample	Dummy variable that takes the value 1 if a primary regression analysis did not focus exclusively on one of the defined regions (NA, Asia, EU) and 0 otherwise.
HighInfoAsym	Dummy variable that takes the value 1 if a primary regression analysis focusses exlcusively on firms that are subject to high information asymmetries and 0 otherwise.
IVDiD	Dummy variable indicating that the regression model of the primary study follows a difference-in-differences methodology.
LogAvgSampleYear	Logarithm of the average sample year of a primary regression analysis.
LogObservations	Logarithm of the observations (firm years) of a primary regression analysis.
OLS_IndFE	Dummy variable indicating that the regression model of the primary study is a stanard OLS regression with industry-fixed effects.
OLS_TimeFE	Dummy variable indicating that the regression model of the primary study is a stanard OLS regression with time-fixed effects.
OLS_IndTimeFE	Dummy variable indicating that the regression model of the primary study is a stanard OLS regression with industry- and time-fixed effects.

Appendix A Continued

Variable	Description
VarCentral	Dummy variable that takes the value 1 if a determinant was a treatment variable and the value 0 if a determinants was a control variable, in the respective primary study.
Capx	Dummy variable that takes the value 1 if a primary regression model contained a measure of capital expenditures as control variable and 0 otherwise.
CF	Dummy variable that takes the value 1 if a primary regression model contained a measure of cash flow as control variable and 0 otherwise.
Datastream	Dummy variable that take the value 1 if a primary regression analysis obtains accounting data from Datastream and 0 otherwise.
Div	Dummy variable that takes the value 1 if a primary regression model contained a measure of dividends as control variable and 0 otherwise.
FinDistr	Dummy variable that takes the value 1 if a primary regression model contained a measure of financial distress as control variable and 0 otherwise.
Firmsize	Dummy variable that takes the value 1 if a primary regression model contained a measure of firm size, usually total assets, as control variable and 0 otherwise.
Lev	Dummy variable that takes the value 1 if a primary regression model contained a measure of leverage as control variable and 0 otherwise.
MB	Dummy variable that takes the value 1 if a primary regression model contained the market-to-book ratio as control variable and 0 otherwise.
NWC	Dummy variable that takes the value 1 if a primary regression model contained a measure of net working capital as control variable and 0 otherwise.
RD	Dummy variable that takes the value 1 if a primary regression model contained a measure of R&D expenditures as control variable and 0 otherwise.
TotalGov	Dummy variable that takes the value 1 if a primary regression model contained a measure of corporate governance as control variable and 0 otherwise.
OtherDataB	Dummy variable that take the value 1 if a primary regression analysis obtains accounting data from databases different from Compustat and Datastream and 0 otherwise.

Appendix A briefly describes all variables used in this study. The construction of the cash holding determinants is explained in more detail in section 3.2.

Appendix B Final Sample of Primary Studies

Study	Countries	Region	Period
Kim/Mauer/Sherman (1998)	US	US	1975-1994
Opler/Pinkowitz/Stulz/Williamson (1999)	US	US	1971-1994
Pinkowitz/Williamson (2001)	US, Ger, Japan	Global, EU, Asia, US	1971-1994
Ozkan/Ozkan (2004)	UK	EU	1998-1995
Acharya/Almeida/Campello (2007)	US	US	1971-2001
Dittmar/Mahrt-Smith/Servaes (2007)	US	US	1990-2003
Drobetz/Grüninger (2007)	Swiss	EU	1995-2004
Foley/Hartzell/Titman/Twite (2007)	US	US	1982-2004
Kalcheva/Lins (2007)	Broad international sample	Global	1996
Chen (2008)	US	US	2000-2004
D'Mello/Krishswami/Larkin (2008)	US	US	1985-2000
García-Teruel/Martínez-Solano (2008)	Spain	EU	1996-2001
Harford/Mansi/Maxwell (2008)	US	US	1993-2004
Bates/Kahle/Stulz (2009)	US	US	1980-2006
Chen/Chuang (2009)	US	US	1997-2003
Lee/Lee (2009)	UK	EU	2001-2005
Duchin (2010)	US	US	1990-2006
Tong (2010)	US	US	1993-2000
Al-Najjar/Belghitar (2011)	UK	EU	1991-2008
Kuan/Li/Chu (2011)	UK	EU	1997-2008
Kusnadi (2011)	Malaysia, Singapore	Asia	2000-2005
Lee/Powell (2011)	Australia	Australia	1990-2008
Subramaniam/Tang/Yue/Zhou (2011)	US	US	1988-2006
Álvarez/Sagner/Valdivia (2012)	Chile	Global	1986-2009
Chen/Chen/Schipper/Xu/Xue (2012)	China	Asia	2000-2008
Julio/Yook (2012)	Broad international sample	Global	1980-2005
Khieu/Pyles (2012)	US	US	1985-2009
Brisker/Colak/Peterson (2013)	US	US	1971-2006
Huang/Elkiwy/Jain (2013)	Broad international sample	Global	1992-2009
Steijvers/Niskanen (2013)	US	US	1998
Sun/Yung/Rahman (2013)	US	US	1980-2005
Yu/Sopranzetti/Lee (2015)	Taiwan	Asia	1991-2005
Belghitar/Clark (2014)	UK	EU	2000-2004
Chen/Li/Xiao/Zou (2014)	China	Asia	2005-2007
Harford/Klasa/Maxwell (2014)	US	Asia	1980-2008
Hill/Fuller/Kelly/Washam (2014)	US	Asia	1999-2006
Hoberg/Phillips/Prabhala (2014)	US	Asia	1997-2008
Iskandar-Datta/Jia (2014)	Broad international sample	Global	1985-2008
Liu/Mauer/Zhang (2014)	US	US	2006-2011
Neamtiu/Shroff/White/Williams (2014)	US	US	1987-2009
Oler/Picconi (2014)	US	US	1989-2008
Qiu/Wan (2014)	US	US	1982-2001
Chen/Dou/Rhee/Truong/ Veeraraghavan (2015)	Broad international sample	Global, US	1989-2009
Elyasiani/Zhang (2015)	US	US	1996-2008
Liu/Luo/Tian (2015)	China	Asia	2004-2011

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Teil 4

How to Induce Persistent, Value-Increasing, Cash Holding Policies: The Effect of Long-Term Incentives

How to Induce Persistent, Value-Increasing, Cash Holding Policies: The Effect of Long-Term Incentives

J. Felix Weidemann*

Abstract

This study exploits a German legal-initiative on incentive-based compensation and reveals that managerial compensation contingent on long-term performance increases the long-term focus in cash holding policies. Prior research reports that such persistent cash holding policies increase the value of cash. Consequently, this analysis identifies a real effect of long-term incentives and of the German regulation, and finds an instrument to increase the value of cash. These insights indicate potential effects of a proposed US regulation sharing several features with the German regulation. Finally, this study proposes a novel setting to address some of the endogeneity in research on long-term incentives.

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Keywords: cash holdings; cash policy; abnormal cash; incentive-based compensation

JEL classification: G3, G30, G32, G34

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1. Introduction

This study shows how variable executive compensation contingent on the corporate long-term performance is associated with the persistence of corporate cash holding policies. I document that cash holding policies become more persistent when long-term compensation incentives (LTIs) increase. This effect is especially pronounced in high-cash firms. I define a cash holding policy or strategy as the association between the characteristics of a firm and the level of cash. Cash holding policies describe how firms adjust their level of cash in response to specific firm situations and firm characteristics. These policies are persistent when a firm's cash stock reacts to the firm's characteristics in the same way over multiple periods, i.e. the association between the level of cash and the firm's characteristics does not change. Exemplarily, a firm may pursue a strategy that strongly trades off cash holdings against debt, meaning a highly negative association between debt and the level of cash. In this situation, a persistent cash holding policy means that the cash level increases (decreases) when debt decreases (increases). A deviation from this policy occurs when cash holdings as well as leverage increase (decrease) simultaneously.

Prior research has shown that more persistent cash holding policies are associated with increases in the market value of cash holdings. Thus, this study identifies a novel real effect of LTIs by showing that they are a potential tool to influence the persistence of cash holding policies. This shows that the value of cash holdings can be managed by influencing the

persistence of cash holding policies, which means that LTIs motivate firms to employ cash holding strategies that benefit firm value. Moreover, this result represents a real effect of a German regulation on LTI compensation that helps assessing a similar proposed regulation in the US. This regulatory set-up also reduces some of the common endogeneity problems in LTI research and thus offers a new perspective for this stream of research to derive more causal inferences.

The market value of cash holdings is regularly found to be smaller than 1, which means that firm value increases by less than $1 if an additional dollar is held in cash. This shows that the corporate cash stock is perceived to be rather harmful than beneficial as Pinkowitz et al. (2006) and Faulkender/Wang (2006) point out. This perception of the cash stock corresponds to Jensen (1986) and implies that managers hoard cash to avoid external control, to exploit shareholders, and to act in self-interest. Thus, the value of cash reflects the investors' perception of how beneficial a firm's cash holding strategy is for firm value. Prior research has revealed three instruments to increase the market value of cash holdings: corporate governance, financial distress, and the persistence of cash holding policies. The prior two drivers are well investigated. Dittmar/Mahrt-Smith (2007) show that the market value of cash ranges between $0.42 and $0.88 in poorly governed firms. This value is doubled for well governed firms. Similar results are derived by Pinkowitz et al. (2006), Kalcheva/Lins (2007), Frésard/Salva (2010), and Huang et al. (2013). Denis/Sibilkov (2010) and Faulkender/Wang (2006) report the value of cash to increase

when firms become financially constrained, i.e. more likely to suffer from financial distress. The latter document a value of $1.04 for cash held by constrained firms, compared to a value of $0.77 in unconstrained firms.

However, actively controlling the value of cash as a manager is difficult with these determinants. Corporate governance consists of various instruments that affect each other. Thus, it is a challenge to establish and maintain a comprehensive system of high quality corporate governance (Larcker et al. 2007, Bhagat et al. 2008, and Brown et al. 2011). Moreover, firms are unlikely to voluntarily evoke financial distress to increase the value of cash.

In contrast, the third instrument, the persistence of cash holding policies, is not researched intensively. Prior studies have documented that the market value of cash increases when the level of cash becomes more constant and a firm's cash policies are more persistent (Mikkelson/Partch 2003 and Oler/Picconi 2014). This observation is explained by the belief that investors appreciate persistent cash policies because they are easier to interpret and to predict since they convey less ambiguous information about the origin and usage of the cash stock (Oler/Picconi 2014). Shareholders do not appreciate unexpected deviations from prior cash strategies because they cannot tell if they are driven by agency motives. Despite the value-increasing effect of persistent cash holding policies, it has not been investigated how cash holding policies can be made more persistent.

Long-term incentives in executive compensation are a popular instrument that is employed to motivate a stronger long-term perspective in managerial planning, but they receive little attention in recent research (Li/Wang 2016). They tie the managerial compensation to the corporate long-term performance to mitigate managerial short-termism. The induced strategical long-term perspective embraces all corporate decisions including cash holding policies. However, empirical studies on the effects as well as determinants of LTIs are scarce and the specific link between long-term incentives and cash holding policies has not been investigated.

Research on the interplay of managerial compensation and the level as well as the market value of cash holdings finds that the level of cash decreases and the market value of cash increases when the interests of managers and shareholders are aligned (Liu/Mauer 2011, Tong 2010, and Chava/Purnanandam 2010). These studies focus on the alignment of interest by compensating managers with equity-options, which motivates them to take more risks. It is not addressed how compensation is linked to the persistence of cash holding policies. Gopalan et al. (2014) and Li/Wang (2016) are rare examples of recent empirical studies that focus on long-term incentives different from pensions. They point out various determinants of long-term compensation incentives such as growth opportunities, more long-term assets, lower risk, better stock performance, lower accruals that inflate earnings, less variable stock performance, and independent boards. They are unable to identify causal effects of long-term incentives, because they exclusively regard

the self-selected voluntary adoption of LTIs, and do not address their effect on cash holding policies.

An ideal setting to investigate the effects of long-term incentives and especially their ability to make cash holding policies more persistent is an exogenous shock to the long-term incentives in a random group of firms. This is necessary because the association of cash holding policies with compensation is endogenous. Similar to the argumentation provided by Gopalan et al. (2014), the relationship can be affected by omitted variables such as firm risk or information asymmetries. Higher firm risk implies more risky cash flows which can lead to a switch from long-term invectives to short-term incentives to limit the riskiness of the CEO's compensation. At the same time, firms with riskier cash flows may tend to increase the cash stock as a precaution to ensure financing future projects although other firm characteristics did not change which represents a change in the cash holding policy. In firms with high information asymmetries, shareholders and the board may introduce long-term incentives to align interests. However, managers may tend to build up the cash stock to avoid external discipline when information asymmetries are high.

The SEC and other US agencies proposed a shock in the form of a regulatory initiative on incentive–based compensation in 2016. This rule is supposed to foster the strategical long-term planning of firms, which also increases the long-term perspective in cash holding policies. This extension of the Dodd-Frank Act aims, amongst others, to prohibit incentive-

based compensation that motivates “inappropriate risks”, which could lead to “material financial loss”. Avoiding such risks and associated financial losses means focusing on the profitable long-term development of a firm. Thus, the regulatory proposal uses long-term incentives as an instrument to avoid managerial short-termism which could also make cash holding policies more persistent.

A similar regulatory initiative, namely the Act on the Appropriateness of Management Board’s Compensation (VorstAG), was introduced in Germany in 2009. The VorstAG serves as a suitable setting to test the effect of long-term incentives and helps to assess one potential effect of the proposed US regulation. The German regulation provides a shock to managerial long-term incentives in compensation by forcing German firms to raise the proportion of long-term incentives in managerial compensation. Thus, it allows investigating how a switch towards long-term incentives in executive compensation is associated with the persistence of cash holding policies. I exploit this shock to long-term incentives by comparing two groups of German firms. I use German firms that are not affected by the VorstAG, because they already employed long-term incentives before the regulation became effective, as the control group and compare them to German firms that started employing long-term incentives after the VorstAG was introduced.

The absolute residual level of cash resulting from a model that explains the cash level based on the seminal study by Opler et al. (1999) serves as a proxy for the persistence of cash holding proxies. Corresponding to my definition of cash holding policies, this variable

does not indicate the level of cash but the explanatory power of the past associations between the level of cash and firm characteristics for the current level of cash. If the past influence of firm characteristics on the level of cash is still relevant to explain the current cash level, the absolute residual is small and indicates persistent cash holding policies. I find that the VorstAG is associated with an increase in the persistence of cash holding policies in treated firms compared to the control group, i.e. the absolute residual decreases in treated firms. An interaction of the difference-in-differences effect with the level of cash reveals that the effect of the VorstAG increases with the level of cash. Finally, I document that cash holding policies can become too persistent and exhibit value-decreasing effects. However, the overall association between the persistence of cash holding policies and the market value of cash is positive, as expected.

I contribute to existing research by establishing a link between executive compensation and the persistence of cash holding policies to investigate how long-term incentives in executive compensation induce persistence to the management's cash holding policy. This makes persistent cash holding policies an instrument to influence the market value of cash, which ultimately means that firms employ cash holding policies in a way that increases firm value. Moreover, this study investigates an aspect of compensation that is novel to cash holding research: It analyzes the effect of an increase in the proportion of variable compensation that is contingent on the corporate long-term performance. This article also contributes to research on executive compensation in general by revealing a novel real

effect of long-term compensation incentives and reducing some of the endogeneity affecting prior studies. I find a setting that does not rely on the voluntary adoption of LTIs by a self-selected group of firms but instead investigate the mandatory adoption of LTIs by all German firms. Finally, this study is relevant for regulators because it investigates a real effect of the German regulation on incentive-based compensation. From an US perspective, this real effect helps in assessing the potential consequences of a similar rule on incentive–based compensation proposed by the SEC and other agencies in the US.

The remainder of this study is structured as follows: I review associated literature and derive the testable hypothesis in section 2. Section 3 introduces the research design and data set. Section 4 presents the empirical results and robustness tests for the association between LTIs and the persistence of cash holding policies. Section 5 investigates the value effects of cash holding persistence for different levels of persistence. I conclude in section 6.

2. Literature Review and Hypothesis

2.1 Persistent Cash Holding Policies and the Market Value of Cash

The persistence of a firm's cash holding policy has been shown to influence the value of cash, but only takes a minor role in existing research. Mikkelson/Partch (2003) explicitly investigate the effect of cash holding persistence on firm performance and firm value. They compare a sample of firms that sustain a high cash ratio for 5 years to firms that are matched by size and industry or their cash holding behavior. Results suggest that a cash

balance that is kept high constantly does not harm operating performance and firm value but rather increases both metrics in comparison to matched firms. Moreover, they find that firms with persistently high cash holdings exhibit higher capital and R&D expenditures than matched firms with a more variable cash holding policy.

Oler/Picconi (2014) build on the cash-models of Opler et al. (1999) and Bates et al. (2009) to analyze excess and abnormal cash holdings. They estimate a firm's normal level of cash by determining the association between the firm's characteristics and the level of cash for past periods. Then the current firm characteristics are combined with these lagged associations to derive the predicted normal level of cash. Oler/Picconi (2014) go on to calculate the difference, i.e. the residual, between a firm's actual cash level and its predicted normal level of cash, the so called excess or abnormal cash holdings. Excess cash holdings represent positive deviations from the predicted normal level of cash, whereas absolute excess cash includes positive as well as negative deviations. I regard abnormal cash as a short-term divergence from the long-term cash policy because it measures whether the association between firm characteristics and the level of cash derived from prior periods is able to explain the current cash level. Thus, high values of abnormal cash represent a change in the reaction of a firm's cash stock to the set of firm characteristics, i.e. a deviation from the prior cash holding policy. Oler/Picconi (2014) report this deviation to be negatively associated to a firm's future accounting performance and stock returns. This

relationship holds in case of excess as well as insufficient cash holdings. Overall, this points out the harmful character of deviations from long-term cash holding policies.

Chen/Shane (2014) employ an empirical model similar to Oler/Picconi (2014) but focus on the abnormal changes of cash instead of the abnormal cash level. It indicates that the association between the change of the cash stock and the set of firm characteristics differs from prior periods, i.e. the firm policy that determines the change of cash is altered. Chen/Shane (2014) find abnormal changes of cash to be associated with decreasing future earnings and stock returns. This confirms the prior notion that deviations from long-term cash policies decrease the corporate performance and the market value of cash.

Further research largely focusses on excess cash. These studies investigate the usage of excessively high cash levels but do not identify causes for deviations from long-term cash policies, i.e. absolute deviations from the predicted normal cash level. In this vein, Iskandar-Datta/Jia (2014) show that excess cash is used for investments, which is especially pronounced in countries with weak investor protection. Sheu/Lee (2012) report that excess cash is associated with capital expenditures and this relation is stronger when firms face financial distress or managers are entrenched.

From a theoretical viewpoint, the capital market's negative reaction to short-term variations in cash holding policies can be explained in two ways. First, the trade-off theory, when applied on cash holdings, suggests that there is an optimal level of cash. This optimal level is determined by the costs and benefits of holding cash such as missed returns from

investing the hoarded cash stock or greater future investment flexibility, as Opler et al. (1999) point out. Consequently, deviations from the optimal level of cash, which are approximated by the abnormal cash variable, signal an inefficient cash management, which is punished by the capital market and results in lower operating performance.

Secondly, Oler/Picconi (2014) argue that shareholders react to abnormal cash levels because they are unable to fully understand the information conveyed by a deviation from the long-term cash holding policy. Abnormal amounts of cash may indicate that operating cash flows are higher than expected and consequently a firm faces fewer financial constraints. At the same time, cash levels that exceed the long-term level of cash are tied to agency costs, specifically inefficient acquisitions as shown by Harford (1999) and Oler (2008). If a negative abnormal cash level occurs, i.e. the cash level falls below the long-term level of cash, shareholders may appreciate the associated decreased risk of agency problems. However, this may also signal surprisingly low operating cash flows and increased financial constraints. Thus, short-term variations in cash holding policies are difficult to interpret by investors and may therefore negatively affect a firm's stock price.

2.2 Managerial Compensation, Long-term Incentives, and Cash Holdings

Research on the relation between management compensation and cash holdings focuses on how compensation affects the riskiness of managerial behavior. It contrasts the effects of compensation that motivates risky behavior with the effects of compensation that does

not emphasize riskiness. Associated studies mostly analyze stock options granted to managers. Specifically, they use the parameters delta and vega, derived from the Black/Scholes (1973) model, as measures for incentive to take risks. Delta is the sensitivity of the option value to changes in the price of the underlying asset, while vega represents the sensitivity of the option value to the volatility of the underlying asset. As Belghitar/Clark (2014) note, there is no common interpretation for the role of delta and vega in cash holding research. Both proxies have been used to represent strong incentives for risky behavior as well as compensation incentives that do not promote excessive riskiness.

Tong (2010) interprets delta as well as vega as proxies for risk-induction and finds a negative association between vega and the level of cash. This indicates that the cash level declines when the managerial actions become more risky. Furthermore, Tong (2010) notes that the market value of cash is higher in high-vega firms, which means that shareholders appreciate increased riskiness. In contrast, Liu/Mauer (2011) interpret delta to increase riskiness but vega to decrease it. They find delta to be negatively associated with the cash level, while vega has a positive association. Thus, increased riskiness in managerial behavior is again linked to a decreasing cash level. Chava/Purnanandam (2010) alter the previous interpretation. They employ delta to represent lower incentives for risky actions and vega as a proxy for higher risk-taking incentives and report a positive association between delta and the cash level but a negative between vega and the cash level. Despite

the conflicting interpretation of delta and vega, all prior studies claim that their results confirm the notion that increased managerial risk-taking is associated with decreases in the cash level. It remains ambiguous how to manage the level of cash and how to increase the market value of cash because it is not clear which part of managerial compensation affects the riskiness of managerial actions.

Neamtiu et al. (2014) switch the focus of research by using the relation of the value of CEO options scaled by total CEO compensation and find a negative association between this proxy and the level of corporate cash. This approach is motivated by Jensen/Meckling (1976)'s Free Cash Flow-Hypothesis, which suggests that available cash is a source and an instrument of managerial discretion. A central goal of compensation is to align managerial and shareholders' interests and decrease the management's incentives to act in discretion. CEO options are supposed to put the CEO in the role of an equity investor. Consequently, an increasing option-based compensation is expected to make the CEO refrain from excessive cash hoarding and undertaking value-destroying investments.

Literature that connects executive compensation with cash holding research has not yet focused on instruments of long-term incentives in compensation. In general, recent literature on the effects and determinants of long-term compensation incentives is scarce. The seminal paper by Larcker (1983) initiated the empirical interest in LTI compensation and motivated some subsequent studies.[1] Larcker (1983) undertakes an experiment by

[1] Li/Wang (2016) provide an overview of earlier studies on the determinants of LTIs and associated capital market reactions.

comparing firms that chose to adopt long-term compensation plans to non-adopting firms. They find adopting firms to exhibit a larger growth in capital expenditures and a positive capital market reaction. Tehranian et al. (1987) report a more positive stock market reaction in divesting companies that employ LTIs in comparison to divesting Non-LTI firms. Gopalan et al. (2014) and Li/Wang (2016) are to my knowledge the only more recent articles that empirically investigate LTIs. Gopalan et al. (2014) establish a novel metric for LTIs by calculating the duration of executive compensation as the weighted average duration of executive pay consisting of salary, bonus, restricted stock, and stock options. They find longer pay duration to be positively associated with growth opportunities, long-term assets, greater R&D intensity, lower risk, and better stock performance. A negative relation is found between pay duration and earnings-increasing accruals. However, Gopalan et al. (2014) are unable to provide causal inferences because they are for example unable to identify whether the pay duration increases growth opportunities or vice versa. Li/Wang (2016) model the choice to generally adopt a long-term compensation contract as well as the choice to adopt specific types of long-term contracts. They document long-term incentives to increase when accounting performance is less variable than stock performance, when shareholders have a long-term horizon, and when boards are independent. Gopalan et al. (2014) and Li/Wang (2016) are able to identify drivers of long-term compensation contracts but do not investigate real effects of such LTIs. Moreover, the seminal studies and also more recent studies suffer from potential endogeneity because

they exclusively investigate cases of voluntary LTI adoption. Such experimental set-ups exhibit a high risk of an omitted variable bias because the self-selected choice to introduce LTIs may be explained by diverging characteristics of adopting firms.

In summary, there are three general observations: First, research argues that cash holdings increase when there are fewer managerial incentives to take risks and more discretionary leeway. Vice versa, cash holdings decrease when incentives for risky actions and interest alignment with the shareholders increase. Second, the market value of cash decreases when incentives for risk-taking decline and managerial discretion increases. Vice versa, the market value of cash increases when managerial risk-taking incentives and interest alignment with shareholders rise. Third, there are no studies on the effect of LTIs on cash holdings and in general no empirical evidence on the real effects of LTIs.

2.3 The VorstAG and International Compensation Regulation

The Act on the Appropriateness of Management Board's Compensation (*Gesetz zur Angemessenheit der Vorstandsvergütung*, VorstAG) became effective in Germany in 2009 and affected the German Stock Companies Act (*Aktiengesetz*), the German Commercial Code (*Handelsgesetzbuch*), as well as the German Corporate Governance Code (*Deutscher Corporate Governance Kodex*). It is based on the "Recommendation on Director's pay: C

(2009)" (2009/385/EC) by the European commission published in April 2009[2] and is mandatory for all publicly listed German firms. The regulation introduces several changes, the most important are: First, the total compensation of executive directors needs to be adequate in relation to the directors' performance and customary in comparison to other firms of the same industry or country. Second, executive compensation needs to motivate a sustainable (long-term) development of the company. This specifically means that variable compensation should partly be based on long-term metrics of performance. Third, the supervisory board has extended possibilities to decrease executive compensation ex-post if firm performance deteriorates. Fourth, the annual stockholders meeting may cast a non-binding vote on the policy of executive compensation. Hitz/Müller-Bloch (2014) find a negative stock market reaction to the announcement of the VorstAG. This observation is mainly driven by stock price discounts in firms that exhibit excessive managerial compensation. Evidence on the real effects of the VorstAG is scarce. Hillebrand (2015) documents a reduction in accrual-based earnings management and a switch to real earnings management in treated firms after the VorstAG was introduced.

The VorstAG affects the design and structure of executive compensation in all publicly listed German firms and has therefore a more extensive scope compared to other compensation regulations. In the US, the Dodd-Frank Act, which became effective in 2010, focuses on say-on-pay requirements and incremental disclosure in public firms. The design

[2] See Commision Recommendation 2009/385/EC which complements the previous recommendations 2004/913/EC and 2005/162/EC, http://ec.europa.eu/internal_market/company/docs/directors-remun/directorspay_290409_en.pdf.

of executive compensation is not directly affected by these regulations. In 2016 it was proposed to expand the Dodd-Frank rules to prohibit "excessive compensation" and "inappropriate risks", which could lead to "material financial loss" and might result in a regulation similar to the VorstAG.[3] In the UK, the Financial Services Authority (FSA) introduced the remuneration code for financial firms, which provides standards that are similar to the VorstAG. The code became effective in 2010 and aims to prevent short-termism. It explicitly states the alignment of compensation with the corporate long-term interests as one of its key principles.[4] The EU introduced a compensation cap for bankers as part of the Capital Requirements Directive IV, which became effective in 2014 and limits the ratio of variable and fixed compensation for European banks and banks that operate in the EU.[5] The Dodd-Frank Act, the UK regulation, and the EU regulation only address financial institutions and have therefore a more narrow scope than the VorstAG. In Switzerland, a referendum resulted in a regulation aimed to prevent excessive compensation in all listed companies. This legal initiative introduced, amongst others, say-on-pay directives and incremental disclosure requirements.[6] In a similar vein, say-on-pay regulations were introduced in various countries between 2003 and 2012 as Correa/Lel (2016) sum up the studies by Larcker et al. (2012) and Murphy (2013). Neither the Swiss

3 See notice of proposed rulemaking and request for comment, https://www.sec.gov/rules/proposed/2016/34-77776.pdf.

4 See Financial Conduct Authority (2016), Chapter 19A IFPRU Remuneration Code, https://www.handbook.fca.org.uk/handbook/SYSC/19A.pdf.

5 See directive 2013/36/EU of the European Parliament and the European Council, https://www.eba.europa.eu/documents/10180/501977/OJ_JOL_2013_176_R_0338_01_EN_TXT.pdf.

6 See Swiss Federal Council, Verordnung gegen übermäßige Vergütung bei börsenkotierten Aktiengesellschaften (VegüV), https://www.admin.ch/opc/de/classified-compilation/20132519/index.html.

nor the other international say-on-pay laws affect the design of compensation contracts and especially not the temporal structure of variable compensation.

Thus, the VorstAG is, to my knowledge, the only compensation regulation that addresses public firms across different industries and enforces a mandatory change in the structure of executive compensation, i.e. an increase in variable compensation contingent on the corporate long-term performance. Despite its large scope, the VorstAG regulation does not provide precise requirements regarding the type of long-term incentives a firm needs to introduce. Thus, it does neither prescribe the usage of certain compensation instruments, such as stocks, options, or long-term cash plans, nor define what is meant by a sustainable (long-term) corporate development. Still, the actual composition of variable executive compensation changed after the introduction of the VorstAG for German public firms because incentives could no longer be exclusively related to the short-term performance, which can be seen in Hillebrand (2015). Consequently, the German legal initiative appears as a suitable event to investigate the real effects of a change in the temporal basis of variable executive compensation.

2.4 Hypothesis

From an agency-based viewpoint, deviations from long-term cash holding policies can be driven by two key reasons: First, the management might hold more cash than their past cash policies suggest because it wants to guard itself against external control and

discipline. This grants the management incremental freedom to pursue its personal goals in discretion as Jensen (1986) suggests. Secondly, the cash level might be lower than prior cash policies predict because the management chooses to invest a larger fraction of the cash stock to benefit itself and to avoid payouts to shareholders as Jensen/Meckling (1976) point out. Both motives to deviate from a long-term cash holding policy can be mitigated by introducing long-term incentives to executive compensation.

However, deviations from prior cash holding policies do not necessarily violate the interests of shareholders. Exemplarily, regulatory initiatives, which affect a firm's operating activities, may change the association between a firm's characteristics and its level of cash. Such a change in the influence of firm characteristics makes a change of the cash holding policy necessary and should serve shareholders' interests. It is in general difficult to distinguish between agency-driven changes in cash holding policies and changes that are a reasonable reaction to fundamental changes in the firm or its environment. Thus, shareholders generally prefer more persistent and long-term oriented cash holding policies to ease the interpretation of such policies as Oler/Picconi (2014) point out.

Long-term incentives punish managers for sacrificing a long-term policy to pursue their short-term personal goals. Deviations from the long-term policy will result in an inefficient development of the firm and in missing the long-term goals of the compensation contract. Consequently, managers will avoid deviating from their long-term cash holding policies, which increases the persistence of cash holding policies. Ultimately, managerial interests

are more aligned with shareholders' interests. Long-term incentives are promoted as a tool to align interests and avoid managerial short-termism in existing literature (Bebchuk/Fried 2004, Holmstrom 2005, and Bhagat/Romano 2009). Edmans et al. (2012) develop a dynamic model to derive optimal compensation contracts that maintain CEO efforts and avoid short-termism. This is achieved by a state-dependent rebalancing of the CEO's wealth consisting of firm stocks and a cash component as well as time-dependent, long-term, vesting. This stresses the importance of LTIs to align managerial and shareholders' interests. The expectation that LTIs will lead to more persistent cash holding policies assumes that such policies are in the interest of shareholders. This can be presumed based on prior evidence that more persistent cash holding policies and decreasing deviations from long-term cash levels increase the value of cash (Mikkelson/Partch 2003, Chen/Shane 2014, and Oler/Picconi 2014). Consequently, I derive the following hypothesis on the effect of the VorstAG, respectively on the association of the persistence of cash holding policies with long-term incentives in management compensation:

***H**: Cash holding policies are more persistent, i.e. less variable, when managerial compensation becomes more contingent on long-term performance.*

This hypothesis expects more persistent cash management strategies in Germany in comparison to other countries, as a result of the VorstAG regulation in 2009.

3. Research Design

3.1 Identification Strategy

Investigating the association between compensation incentives and cash holding policy persistence bears two central difficulties that need to be taken into account in the research design. First, compensation incentives and the persistence of cash holding policies might both be affected by a third, endogenous, influencing factor. For example, a firm might face financial distress. In this case, it finances projects with cash since external financing becomes expensive. This leads to a deviation from the firm's long-term cash level, indicating a higher variability of the firm's cash holding policy. Furthermore, a distressed firm is less profitable and the management has difficulties to achieve its performance targets, which decreases the variable compensation. In this situation decreasing cash holdings, increasing variability of cash holding policies, and declining variable compensation coincide but do not cause each other.

Secondly, even if such an influence from an omitted explanatory factor can be ruled out, a causal interpretation remains unclear because the direction of their relation cannot be determined. Does an increase in incentive-based executive compensation increase the persistence of cash holding policies or does a more persistent policy of holding cash increase corporate profitability, which increases incentive-based compensation?

I exploit a German regulatory initiative that was introduced in 2009 to deal with these issues of identification. The Act on the Appropriateness of Management Board's

Compensation (*Gesetz zur Angemessenheit der Vorstandsvergütung*, VorstAG) requires German public firms to align their compensation structure with a sustainable (long-term) firm development. Public firms need to adopt long-term incentives in their executive compensation to enforce a long-term strategic perspective on their management. These long-term compensation plans make variable compensation partly dependent on long-term firm performance. This means that managerial compensation is deferred for two to five years and made contingent on a firm's future performance. In economic terms, the regulation provides a shock to the compensation structure, specifically to the proportion of the total variable compensation that depends on long-term performance. This change in the compensation structure is neither caused by specific firm characteristics nor chosen by the management or the shareholders.

I compare the persistence of cash holding policies in German firms that used long-term incentives in executive compensation before the VorstAG was introduced (EarlyLTI) with German firms that adopted long-term incentives after the VorstAG was introduced (Non-EarlyLTI). The intuition of this set-up is that the VorstAG regulation had no effect on EarlyLTI firms because their compensation structure already matched the requirements of the VorstAG. Therefore, these firms serve as an untreated control group. The Non-EarlyLTI firms had to adjust their compensation structure according to the VorstAG and consequently represent the group of treated firms. The number of EarlyLTI firms is small, therefore these untreated firms are matched with comparable Non-EarlyLTI firms using

propensity score matching with a nearest neighbor heuristic. In this approach, I estimate the propensity of being an EarlyLTI firm for all German firms with a probit regression model. This probit model employs the variables from the classic cash holding regression by Opler et al. (1999) as explanatory variables.[7] A dummy that takes the value 1 if a firm adopted long-term incentives before the VorstAG became effective (EarlyLTI), 0 otherwise, serves as the dependent variable. The probit regression is run for every yearly cross-section. Yearly expected values of the dependent dummy-variable for each firm, the so-called propensity scores, are the result of this approach. Each EarlyLTI firm is matched with the Non-EarlyLTI firms that has the closest propensity score. The matching procedure is further specified in accordance to the matching procedure in Pinkowitz et al. (2016). This means, I allow a caliper, i.e. a maximum range of difference in the propensity score between an EalryLTI firm and the respective matched firm, of 0.01. This means when an EarlyLTI firm has a propensity score of 0.9, the matched Non-EarlyLTI firm needs to have a propensity score between 0.89 and 0.91. A Non-EarlyLTI firm can only be matched once, i.e. no replacement. Furthermore, I implement the common support condition that requires the matched Non-EarlyLTI firms to have a propensity score that does not exceed/fall below the highest/lowest propensity score in the sample of EarlyLTI firms. Finally, firms from the financial service or utilities sector are dropped from the matching procedure. German firms are forced to report the management's compensation structure since 2006. Thus, EarlyLTI

[7] The explanatory variables are cash holdings, firm size, leverage, capital expenditures, R&D expenditures, dividends, profitability, net working capital, market-to-book ratio, the standard deviation of cash flows, and industry dummies. The variables are defined in section 3.2.

firms are determined from 2006-2008. Information on the existence of long-term incentives during this period is obtained from a hand-collected dataset of the University of Cologne, which is also the data basis for the managerial compensation study by Kuhner et al. (2010-2016) (*Studie Managergehälter* 2010-2016). This study defines LTIs to occur when a firm discloses them and it is apparent that the incentives refer to a time horizon of at least 3 years. This means that an incentive based compensation that is labelled LTI by the reporting firm, but refers to a period of only 1-2 years does not enter this study as a LTI. The EarlyLTI firms identified from 2006-2008 are matched with comparable German Non-EarlyLTI firms in every year from 2001-2015. The result of this propensity score matching procedure is a firm sample that equally consists of treated firms (Non-EarlyLTI) and control firms (EarlyLTI). Subsequently, I employ a difference-in-differences regression on this matched sample of firms to investigate the overall effect of the VorstAG regulation on the persistence of cash holdings policies in treated German firms in comparison to the control group of German EarlyLTI firms.

The identification suffers from some limitations. The control group is not random but self-selected, the pre-treatment period only embraces three years, and the regulatory event may not have surprised firms. These limitations bear the risk of unobserved heterogeneity. However, this empirical set-up still represents an improvement to prior studies because it does not rely on the voluntary adoption of LTIs as a treatment and tries to address the problem unobserved heterogeneity with propensity score matching and the regulatory set-

up. Possible violations of the parallel trends assumption in the pre-treatment period are tested via placebo testing. The VorstAG regulation resulted from the European recommendation 2009/385/EC published on 30th April 2009 which was driven by an invitation of the ECOFIN Council issued 2nd December 2008 motivated by the outbreak of the financial crisis. Thus, firms had little time to adjust their compensation strategies and anticipate the implementation of the VorstAG in 2009, which reduces the risk of an announcement effect during the development of the VorstAG.

3.2 Methodology

The difference-in-differences regression model used in the investigation employs absolute abnormal cash holdings as dependent variable and is depicted in eq. (1):

$$AbsAbnCH_{\mathrm{it}} = \beta_0 + \beta_1 \times DiD_{it} + \beta_2 \times CH * did_{it} + \beta_3 \times treated_{it}$$
$$+\beta_4 \times CH * VorstAG_{it} + \beta_5 \times CH * treated_{it} + \beta_6 \times CH\hat{}2_{it} + \beta_7 \times CH_{it}$$
$$+\beta_8 \times logNetA_{it} + \beta_9 \times RD_{it} + \beta_{10} \times Capx_{it} + \beta_{11} \times NWC_{it} + \beta_{12} \times EBIT_{it}$$
$$+ \beta_{13} \times Lev_{it} + \beta_{14} \times CFsd_{it} + \beta_{15} \times \frac{M_{it}}{B_{it}} + \beta_{16} \times Div_{it} + \beta_{17} \times FF12Ind_{it}$$
$$+\beta_{18} \times FYear_{it} + \beta_{19} \times Country_{it} + \varepsilon_{it} \quad (1)$$

The explanatory variables consist of two categories: First, difference-in-differences indicators. $VorstAG_{it}$ is a dummy variable that takes the value of 1 in firm-years that are later or equal to 2009, 0 otherwise. Thus, it represents the general change in $AbsAbnCH_{\mathrm{it}}$

that occurs over time. In eq. (1), $VorstAG_{it}$ is only depicted as part of interaction terms and not as a stand-alone variable because it represents a time trend and is thus already included in the time dummies ($FYear_{it}$) contained in the model. The dummy variable $treated_{it}$ takes the value 1 for Non-EarlyLTI firms and 0 for EarlyLTI firms. $treated_{it}$ measures the general difference in $AbsAbnCH_{\mathrm{it}}$ between EarlyLTI and Non-EarlyLTI firms. The dummy variable DiD_{it} indicates the difference-in-differences effect. It is the interaction of $VorstAG_{it}$ and $treated_{it}$. Thus, it takes the value 1 for Non-EarlyLTI firms after the introduction of the VorstAG, i.e. after 2008, and indicates how the difference between Non-EarlyLTI and EarlyLTI firms changed over time due to the introduction of the VorstAG. Since EarlyLTI firms are not affected by the VorstAG, the change in the difference between both groups of firms is due to the effect of the VorstAG on Non-EarlyLTI firms.

The second category of explanatory variables are moderators obtained from Compustat Captial IQ Global and North America, item names are stated in parentheses, and are calculated as follows: CH_{it} equals cash and short-term investments (CHE). $logNetA_{it}$ is the logarithm of total assets. Total assets are converted into dollar values by using exchange rates obtained from Thomson Reuters Datastream. RD_{it} is R&D expenditures (XRD). $Capx_{it}$ equals capital expenditures (CAPX). NWC_{it} is net working capital which equals working capital (WCAP) less cash and short-term investments. $EBIT_{it}$ is earnings before interests and taxes. Lev_{it} equals total liabilities (LT). $CFsd_{it}$ is the five-year rolling standard deviation of operating cash flows (OANCF). M_{it}/B_{it} is the market value of equity divided by

total assets less total liabilities. The market value of equity is calculated by multiplying the closing share price (PRCCD) at the end of the fiscal year with the number of common shares outstanding (CSHOC). Div_{it} equals total dividends (DVT). All prior variables, except $logNetA_{it}$ and CFsd, are scaled by total assets. $FF12Ind_{it}$ is a vector of industry dummy variables representing the 12 Fama/French industries. $FYear_{it}$ is a vector of dummy variables representing the respective fiscal year. $CH * did_{it}$ is the interaction of CH_{it} with DiD_{it}. It indicates the effect of the VorstAG on the association between the level of cash and $AbsAbnCH_{\text{it}}$. This interaction also requires interacting CH_{it} with $VorstAG_{it}$($CH * VorstAG_{it}$) as well as $treated_{it}$ ($CH * treated_{it}$). Ultimately, I also add squared cash holdings $CH\text{^}2_{it}$ to the model to account for an indicated non-linear influence of CH_{it} on the dependent variable.

As already mentioned, the dependent variable is absolute abnormal cash ($AbsAbnCH_{it}$), which is the yearly absolute difference between the actual cash level and the predicted normal level of cash derived from the model of Opler et al. (1999). More specifically, I combine the approaches of Faleye (2004) and Oler/Picconi (2014) to estimate the predicted level of cash for each year. The model is shown in eq. (2):

$$CH_{it} = \beta_0 + \beta_1 \times logNetA_{it} + \beta_2 \times RD_{it} + \beta_3 \times Capx_{it} + \beta_4 \times NWC_{it}$$
$$+\beta_5 \times EBIT_{it} + \beta_6 \times Lev_{it} + \beta_7 \times CFsd_{it} + \beta_8 \times \frac{M}{B}_{it} + \beta_9 \times Div_{it}$$
$$+\beta_{10} \times FF12Ind - Dummy_{it} + \beta_{11} \times FYear - Dummy_{it} + \varepsilon_{it} \quad (2)$$

To avoid a peek-ahead bias, the model is predicted on a rolling basis over a 5-year window prior to the respective firm-year under analysis. The resulting rolling 5-year coefficients are used to estimate the normal level of cash by plugging the current values of the respective firm-year into eq. (2). Finally, $AbsAbnCH_{it}$ is the absolute residual that results from this procedure, i.e. the absolute difference between actual and predicted normal level of cash. The underlying idea of this measure is that the predicted normal level is derived from a firm's prior policy of cash holding, i.e. the association between a firm's characteristics and its cash level for the past 5 years. Thus, the predicted normal level of cash is an expectation resulting from the long-term cash holding policies. The actual cash level varies around the predicted normal level. Absolute abnormal cash indicates deviations from the predicted normal cash level, respectively from long-term cash holding policies. This means that a firm's past policy of cash holding is insufficient to explain the actual level of cash, which signals variability in cash holding policies. Vice versa, low values of $AbsAbnCH_{it}$ indicate higher persistence of cash holding policies because the past strategies of cash management are able to explain the actual level of cash. It has to be noted that the regression coefficients in eq. (2), which represent cash holding policies, represent a sample average and not an individual firm. Therefore, abnormal cash holdings indicate an individual firm's deviation from the long-term policies of the entire sample which is the closest approximation of a individual firm's deviation from its own long-term policies that this study can achieve.

$AbsAbnCH_{it}$ is determined from 2001-2015 because the earliest date to determine EarlyLTI firms is 2006. Because of the rolling 5-year window, I end up with observations of $AbsAbnCH_{it}$ for the years 2006-2015.

Finally, the large body of control variables contained in eq. (1) and (2) bears the risk of including bad controls into the analysis. Especially, if the VorstAG induces a long-term focus to the management's strategies, this will affect all firm-level characteristics such as RD_{it} and Div_{it}. Eq. (1) and (2) are tested in reduced form in section 4.3 to explore if the effect of the VorstAG persists in absence of potential bad controls.

3.3 Data & Descriptive Statistics

Table 1 tabulates descriptive statistics for four sub-samples. These consist of German firms that did not employ long-term incentives early and German EarlyLTI firms. Both groups of firms are regarded in two periods: pre- and post-treatment. The sample contains 1546 firm-year observations in total. Most variables show an identical development from the pre- to the post-treatment period for the treated and the control group. The only exception are the level of cash, net working capital and $AbsAbnCH_{it}$. The level of cash increases for untreated EarlyLTI firm by about 3% in the mean and about 31% in the median.

Table 1 Descriptive Statistics: Intra-Germany Quasi-Natural Experiment

This table presents separate descriptive statistics for the period from 2006-2008 and from 2009-2015, i.e. the pre- and post-VorstAG periods for which information on German executives' compensation is available. Panel A exhibits statistics for matched treated German firms which did not use long-term incentives prior to the VorstAG (Non-EarlyLTI). Panel B tabulates statistics for German firms which used long-term incentives prior to the VorstAG (*EarlyLTI*). The matching procedure is described in section 3.1. The matched firms are determined by applying a propensity score matching that uses a nearest neighbor heuristic, the common support hypothesis, no replacement, and a caliper of 0.01. The variables used as regressors in the underlying probit-regression of the propensity score matching procedure correspond to the classic cash-holding model by Opler et al. (1999) and are also incorporated in the regressions of absolute abnormal cash holdings. The tabulated variables are defined in section 3.2.

Panel A: Non-EarlyLTI firms

		Pre-VorstAG (2006-2008)								***Post-VorstAG (2009-2015)***							
		mean	min	p25	p50	p75	max	sd	N	mean	min	p25	p50	p75	max	sd	N
Matched treated German firms (Non-EarlyLTI)	CH	0.157	0.000	0.046	0.110	0.208	0.790	0.161	256	0.155	0.000	0.055	0.112	0.212	0.790	0.137	517
	AbsAbnCH	0.094	0.001	0.043	0.080	0.130	0.482	0.068	256	0.090	0.000	0.038	0.074	0.129	0.415	0.072	517
	logNetA	5.095	1.979	3.782	4.682	6.056	12.054	1.849	256	5.349	1.979	3.834	4.959	6.419	12.374	2.116	517
	Lev	0.549	0.036	0.418	0.583	0.668	0.969	0.186	256	0.546	0.035	0.401	0.557	0.699	0.985	0.197	517
	Capex	0.048	0.000	0.018	0.031	0.067	0.302	0.048	256	0.042	0.000	0.015	0.030	0.058	0.277	0.038	517
	Div	0.017	0.000	0.000	0.002	0.022	0.136	0.030	256	0.020	0.000	0.000	0.008	0.023	0.136	0.031	517
	EBIT	0.068	-0.477	0.030	0.067	0.117	0.323	0.095	256	0.064	-0.319	0.025	0.063	0.100	0.323	0.080	517
	NWC	0.043	-0.433	-0.067	0.051	0.168	0.582	0.178	256	0.041	-0.433	-0.066	0.045	0.138	0.603	0.173	517
	R&D	0.027	0.000	0.000	0.000	0.034	0.237	0.049	256	0.036	0.000	0.000	0.006	0.053	0.237	0.054	517
	M/B	2.141	0.171	0.948	1.444	2.412	16.498	2.439	256	2.267	0.176	1.047	1.652	2.868	15.856	1.999	517
	CFsd	0.065	0.007	0.031	0.051	0.082	0.304	0.054	256	0.053	0.007	0.028	0.042	0.066	0.304	0.041	517

Panel B: EarlyLTI firms

		Pre-VorstAG (2006-2008)								***Post-VorstAG (2009-2015)***							
		mean	min	p25	p50	p75	max	sd	N	mean	min	p25	p50	p75	max	sd	N
Untreated German (EarlyLTI)	CH	0.158	0.001	0.036	0.088	0.220	0.790	0.168	256	0.164	0.003	0.046	0.116	0.226	0.752	0.154	517
	AbsAbnCH	0.093	0.001	0.033	0.081	0.133	0.424	0.075	256	0.093	0.000	0.033	0.075	0.137	0.378	0.075	517
	logNetA	5.228	2.143	4.106	4.905	6.113	11.524	1.747	256	5.373	2.221	4.123	5.039	6.276	11.950	1.881	517
	Lev	0.539	0.098	0.410	0.574	0.669	0.966	0.179	256	0.530	0.096	0.416	0.527	0.676	0.972	0.182	517
	Capex	0.050	0.001	0.020	0.037	0.062	0.302	0.048	256	0.041	0.001	0.015	0.034	0.056	0.236	0.035	517
	Div	0.017	0.000	0.000	0.005	0.023	0.136	0.027	256	0.020	0.000	0.000	0.010	0.025	0.136	0.030	517
	EBIT	0.068	-0.405	0.027	0.066	0.109	0.323	0.092	256	0.063	-0.358	0.026	0.063	0.102	0.323	0.088	517
	NWC	0.047	-0.433	-0.043	0.038	0.166	0.539	0.179	256	0.053	-0.433	-0.048	0.043	0.178	0.559	0.174	517
	R&D	0.020	0.000	0.000	0.000	0.029	0.237	0.036	256	0.023	0.000	0.000	0.004	0.032	0.219	0.037	517
	M/B	2.032	0.171	0.900	1.438	2.533	12.701	2.011	256	2.138	0.171	1.060	1.526	2.264	16.498	2.223	517
	CFsd	0.063	0.007	0.032	0.051	0.079	0.304	0.047	256	0.050	0.007	0.026	0.041	0.068	0.195	0.035	517

The cash level is more constant in treated Non-EarlyLTI firms which show decline in the mean by about 1% and an increase in the median by about 2%. EarlyLTI firms show an unambiguous decline in net working capital whereas Non-EarlyLTI firms exhibit a pronounced increase in net working capital by around 12% in the mean and median. The mean and median level of $AbsAbnCH_{it}$ declines in treated Non-EarlyLTI firms by about 4%, respectively 7%. In contrast, untreated EarlyLTI firms exhibit constant $AbsAbnCH_{it}$ in the mean and a decrease by 8% in the median. This indicates that the VorstAG induced a more pronounced decline of $AbsAbnCH_{it}$ and consequently an increase in the persistence of cash holding policies in German firms that did not employ long-term incentives before the regulation.

Table 2 analyzes the correlation of all variables contained in eq. (1). Panel A provides an overview for all dependent and explanatory variables. It reports a positive correlation between $AbsAbnCH_{it}$ and CH_{it}. Panel B investigates this correlation between $AbsAbnCH_{it}$ and CH_{it} in more detail. It undertakes a sub-sample analysis for Non-EarlyLTI as well as EarlyLTI firms, post and prior to the VorstAG. Moreover, this analysis compares correlations for firms whose cash level is higher/lower than the median level of cash. Panel C is equivalent to panel B but uses a different definition for high- and low-cash firms. Here, high-cash firms are within the upper quartile of CH_{it}, while low-cash firms are within the lower quartile of CH_{it}

Overall, panel B and C reveal a non-linear association between $AbsAbnCH_{it}$ and CH_{it} when all sub-samples are regarded in aggregate. Moreover, the Non-EarlyLTI sample features a less strong increase in the correlation between $AbsAbnCH_{it}$ and CH_{it} during the transition from the Pre- to the Post-VorstAG period for high-cash firms. Panel B shows that the correlation between $AbsAbnCH_{it}$ and CH_{it} increases by about 74% in EarlyLTI high-cash firms, whereas their Non-EarlyLTI counterparts exhibit only a growth of 20% in the correlation. Low-cash firms do not exhibit such a difference in the development of correlations: In EarlyLTI firms there is a decline of 37%, Non-EarlyLTI firms display a decline of about 33%.

The altered sub-samples of panel C corresponds to the previous observation but generally exhibits more extreme changes in the correlations. Untreated EarlyLTI high-cash firms exhibit a stronger increase than Non-EarlyLTI high-cash firms (258% vs 191%). This observation is inverted when low-cash firms are regarded.

Non-EarlyLTI as well as EarlyLTI low-cash firms exhibit a decline in the correlation of $AbsAbnCH_{it}$ and CH_{it} but this decline is more pronounced in EalryLTI firms (-79% vs -89%). When the sub-samples of panel B and C are regarded in aggregate, an inverted S-curved association is found between $AbsAbnCH_{it}$ and CH_{it} for both samples in the Pre-VorstAG period. This pattern changes to an inverted U-curve for both samples in the post-treatment period.

Table 2: Analysis of correlations

This table presents pearson correlation coefficients and significance. Panel A reports correlations for all variables used in model shown in equation (1). The respective variabels are defined in section 3.2. Panel B tabulates the correlation between cash holdings and absolute abnormal cash, before and after the introduction of the VorstAG, for German firms and matched international firms, as well as for firms which hold more than (less than) as the median firm-level of cash. Panecl C exhibits correlations between cash holdings and absolute abnormal cash holdings for the same firms and time periods as panel B but for the 25% and 75% quartile of the cash level. P-value are shown below each correlation coefficient. All firm-years before 2009 are identified as pre-VorstAG and all firm-years after 2008 are identifiedas Post-VorstAG. The matching of German and international firms is described in section 3.1, the derivation of sub-samples based on the level of cash is described in section 3.3.

Panel A - Pearson correlations

	CH	AbsAbnCH	logNetA	Lev	Capex	Div	EBIT	NWC	R&D	M/B	CFsd
CH	1.000										
AbsAbnCH	0.350	1.000									
	0.000										
logNetA	-0.270	-0.170	1.000								
	0.000	0.000									
Lev	-0.520	-0.160	0.330	1.000							
	0.000	0.000	0.000								
Capex	-0.200	-0.060	0.070	0.110	1.000						
	0.000	-0.030	0.000	0.000							
Div	0.230	0.110	0.050	-0.210	0.000	1.000					
	0.000	0.000	-0.020	0.000	-0.880						
EBIT	0.010	-0.040	0.230	-0.050	0.020	0.400	1.000				
	-0.600	-0.110	0.000	-0.020	-0.280	0.000					
NWC	-0.140	-0.230	-0.080	-0.360	-0.010	0.090	0.130	1.000			
	0.000	0.000	0.000	0.000	-0.510	0.000	0.000				
R&D	0.190	0.040	-0.100	-0.250	-0.060	0.000	-0.100	0.080	1.000		
	0.000	-0.080	0.000	0.000	0.000	-0.840	0.000	0.000			
M/B	0.110	0.130	-0.060	0.130	0.010	0.270	0.260	-0.200	0.050	1.000	
	0.000	0.000	0.000	0.000	-0.640	0.000	0.000	0.000	-0.010		
CFsd	0.200	0.160	-0.360	-0.120	-0.010	-0.040	-0.260	-0.050	0.100	0.130	1.000
	0.000	0.000	0.000	0.000	-0.500	-0.050	0.000	-0.030	0.000	0.000	

Table 2: Continued

Panel B - Correlation between cash holdings and absolute abnormal cash separated by the median of the cash level

		Pre-VorstAG (2006-2008)					*Post-VorstAG (2009-2015)*				
Treated German firms (Non-EarlyLTI)		*Cash holdings > median*			*Cash holdings <median*		*Cash holdings > median*			*Cash holdings < median*	
		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH
	CH	1.00		CH	1.00		CH	1.00		CH	1.00	
	AbsAbnCH	0.31	1.00	AbsAbnCH	0.61	1.00	AbsAbnCH	0.37	1.00	AbsAbnCH	0.41	1.00
		0.00			0.00			0.00			0.00	
Untreated German firms (Early LTI)		*Cash holdings > median*			*Cash holdings <median*		*Cash holdings > median*			*Cash holdings < median*	
		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH
	CH	1.000		CH	1.00		CH	1.00		CH	1.00	
	AbsAbnCH	0.190	1.000	AbsAbnCH	0.65	1.00	AbsAbnCH	0.33	1.00	AbsAbnCH	0.41	1.00
		-0.080			0.00			0.00			0.00	

Panel C - Correlation between cash holdings and absolute abnormal cash separated by quantiles of the cash level

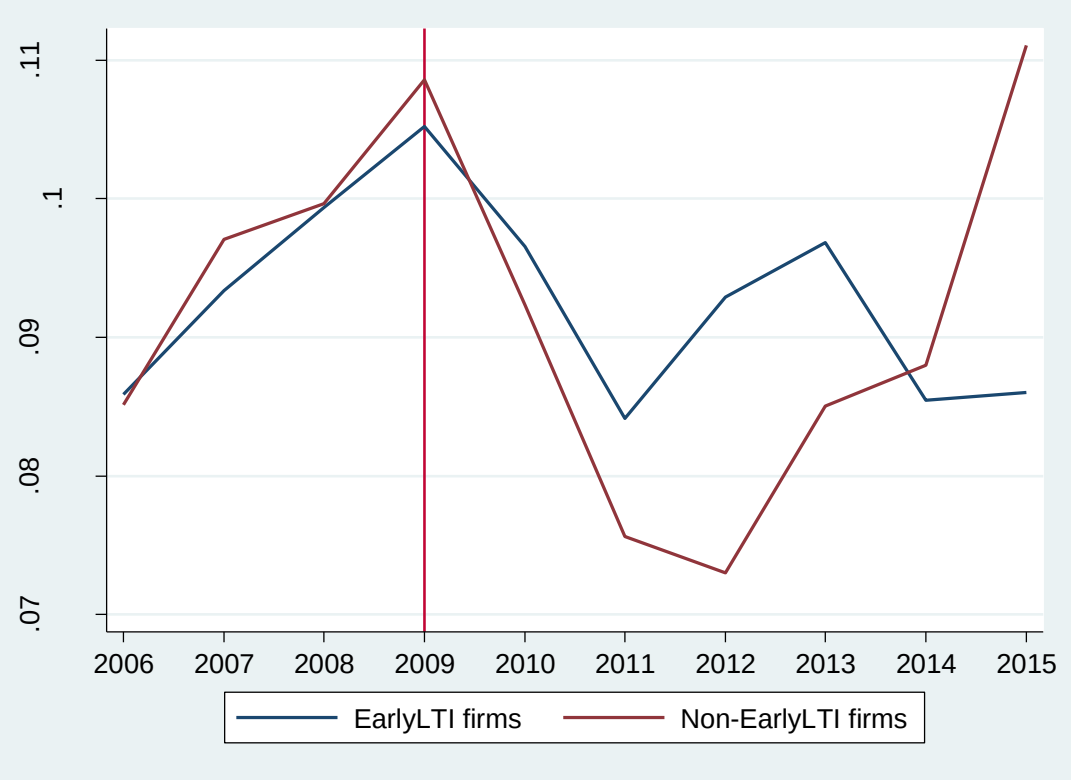
		Pre-VorstAG (2006-2008)					*Post-VorstAG (2009-2015)*				
Treated German firms (Non-EarlyLTI)		*75% quartile cash holdings*			*25% quartile cash holdings*		*75% quartile cash holdings*			*25% quartile cash holdings*	
		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH
	CH	1.00		CH	1.00		CH	1.00		CH	1.00	
	AbsAbnCH	0.11	1.00	AbsAbnCH	0.63	1.00	AbsAbnCH	0.32	1.00	AbsAbnCH	0.13	1.00
		-0.62			0.00			-0.01			-0.24	
Untreated German firms (Early LTI)		*75% quartile cash holdings*			*25% quartile cash holdings*		*75% quartile cash holdings*			*25% quartile cash holdings*	
		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH		CH	AbsAbnCH
	CH	1.00		CH	1.00		CH	1.00		CH	1.00	
	AbsAbnCH	-0.19	1.00	AbsAbnCH	0.65	1.00	AbsAbnCH	0.30	1.00	AbsAbnCH	0.07	1.00
		-0.37			0.00			-0.01			-0.53	

After the introduction of the VorstAG, low-cash firms from panel C exhibit the lowest correlation, whereas low-cash firms according to panel B exhibit the highest correlation closely followed by high-cash firms from panel B. The correlation between $AbsAbnCH_{it}$ and CH_{it}decreases again for high-cash firms according to panel C.

Figure 1 compares the evolution of the yearly mean-level of $AbsAbnCH_{it}$ in Non-EarlyLTI and EarlyLTI firms. The graphic analysis reveals a decline in $AbsAbnCH_{it}$ after the VorstAG was introduced. This effect is most pronounced and persistent in treated Non-EarlyLTI firms, indicating the effectiveness of the VorstAG. However, figure 1 also indicates that the effect of the VorstAG wears off by reporting a high growth in $AbsAbnCH_{it}$ for EarlyLTI firms in 2013 and 2015. Finally, the graph indicates a somewhat parallel trend in the treatment and control group during the pre-treatment period but does not provide strong evidence. This concern is analyzed and mitigated in section 4.4 by performing placebo tests.

Figure 1 Absolute Abnormal Cash Holdings, the Level of Cash, and the VorstAG

Figure 1 illustrates the evolution of absolute abnormal cash holdings from 2006 to 2015 for two groups of German firms. Firms which introduced long-term compensation incentives before the Act on the Appropriateness of Management Board Compensation (VorstAG) became effective in 2009 (EarlyLTI firms) are represented by the blue line. Firms which implanted long-term incentives as a result of the VorstAG in 2009 (Non-EarlyLTI firms) are represented by the red line. EarlyLTI and Non-EarlyLTI firms are matched with a propensity score matching procedure that uses a nearest neighbor heuristic, the common support hypothesis, no replacement, and a caliper of 0.01. The matching approach is described in more detail in section 3.1, the absolute abnormal excess cash variable is defined in section 3.2.



4. Empirical Results

4.1 Matching Treated and EarlyLTI German Firms

In the first part of the analysis, the full difference-in-differences model, depicted in eq. (1), is applied on treated German firms and German EarlyLTI firms from 2006-2015. Table

3 exhibits the results of this investigation. Column 1 employs only the difference-in-differences effect, column 2 interacts this effect with the level of cash, column 3 incorporates squared cash holdings instead of the interaction term, and column 4 applies the interaction term as well as squared cash holdings.

The results show the VorstAG to decrease absolute abnormal cash holdings, which means that the persistence of cash holding policies increases. This effect is primarily driven by a decrease in the association between CH_{it} and $AbsAbnCH$. DiD_{it} exhibits a negative coefficient when it is not interacted with the level of cash, as shown in column 1. This shows that the VorstAG decreases the variability of cash holdings policies overall. The effect of the VorstAG is further explained in the subsequent columns. When the interaction term $CH * did_{it}$ is added in columns 2 and 4, DiD_{it} becomes insignificant which indicates that the negative effect of DiD_{it} in column 1 was driven by the interaction between CH and DiD_{it} which is represented as a separate effect in columns 2 and 4. CH_{it} has a positive effect on $AbsAbnCH_{it}$ and the interaction term $CH * did_{it}$ exhibits a negative coefficient. This disentangles the association between CH_{it} and $AbsAbnCH_{it}$ by indicating that the VorstAG decreases the positive association between the level of cash and absolute abnormal cash holdings. Thus, the negative effect of DiD_{it} found in column 1 is driven by the VorstAG's effect on the association between CH_{it} and $AbsAbnCH_{it}$ captured in $CH * did_{it}$. Consequently, the VorstAG is most effective in motivating more persistent cash holding policies in high-cash firms.

Table 3 Intra-German Difference-in-differences regression

This table presents results from the difference-in-differences model introduced in section 3.2, eq. (1). The model compares untreated German firms that adopted long-term incentives before the VorstAG to German firms that introduced long-term incentives subsequent to the VorstAG. The dependent variable, absolute abnormal cash holdings, as well as all moderating variables are explained in section 3.2. Column 2 incorporates the interaction of cash holdings and the difference-in-differences effect. Column 3-4 add squared cash holdings to the model to account for the potential non-linear influence of the level of cash on absolute abnormal cash holdings. Standard errors are heteroskedasticity-robust and clustered by time and industry. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. All models include time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parantheses.

	Predicted Sign	(1)	(2)	(3)	(4)
DiD	-	-0.0135***	0.00444	-0.00561	-0.00445
		(-2.71)	(0.63)	(-1.15)	(-0.62)
CH*did	-		-0.155***		-0.0710*
			(-3.58)		(-1.86)
treated		0.00490*	0.00239	0.00159	0.00871*
		(1.67)	(0.51)	(0.53)	(1.72)
CH	+	0.0430*	0.0394	-0.312***	-0.333***
		(1.83)	(1.35)	(-7.79)	(-8.41)
CH*VorstAG			0.0311		0.0630***
			(1.34)		(3.39)
CH*treated			0.0303		-0.0136
			(1.02)		(-0.49)
CH^2				0.644***	0.668***
				(9.58)	(10.23)
logNetA		-0.00180**	-0.00160**	-0.00219***	-0.00223***
		(-2.22)	(-1.99)	(-2.96)	(-2.91)
Lev		-0.0973***	-0.1000***	-0.0912***	-0.0945***
		(-5.09)	(-5.32)	(-5.00)	(-5.16)
Capex		-0.0816*	-0.0815*	-0.0631	-0.0624
		(-1.76)	(-1.72)	(-1.36)	(-1.33)
Div		0.140	0.119	0.0378	0.00122
		(1.60)	(1.37)	(0.47)	(0.01)
EBIT		-0.0735***	-0.0693***	-0.0563***	-0.0552**
		(-3.10)	(-2.85)	(-2.78)	(-2.58)
NWC		-0.125***	-0.124***	-0.112***	-0.113***
		(-9.04)	(-9.14)	(-8.02)	(-7.98)
R&D		0.0487	0.0687	0.0579	0.0739**
		(1.12)	(1.61)	(1.63)	(2.10)
M/B		0.00302***	0.00325***	0.00274***	0.00269**
		(2.77)	(2.95)	(2.67)	(2.55)
CFsd		0.0787	0.0888	0.140***	0.144***
		(1.33)	(1.48)	(2.75)	(2.82)
Constant		0.151***	0.148***	0.169***	0.169***
		(10.20)	(9.89)	(11.67)	(11.41)
Time fixed effects		*Yes*	*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*	*Yes*
#observations		1546	1546	1546	1546
R-sq		0.202	0.212	0.284	0.291
Adj. R-sq		0.196	0.203	0.277	0.283

Column 3 and 4 add the squared level of cash to the model to account for the non-linear association between CH_{it} and $AbsAbnCH_{it}$ found in table 2. The inclusion of $CH\text{^}2_{it}$ makes DiD_{it} become insignificant, indicating that the VorstAG partly becomes effective by influencing the non-linear association between CH_{it} and $AbsAbnCH_{it}$, as already mentioned in the discussion of table 2.

4.2 Reduced Models

A concern regarding the validity of the results presented in section 4.1 is related to the control variables contained in the difference-in-differences model. If the VorstAG induces a more long-term focus to managerial strategies, this will not only affect the corporate cash management but all corporate strategies. Thus, the VorstAG would be correlated with most of the explanatory variables employed in table 3, such as $R\&D_{it}$, Lev_{it}, and $EBIT_{it}$. The variance inflation factors related to the respective models do not identify multicollinearity as a major concern. Still, I estimate reduced models to see whether the results hold in absence of potentially bad control variables. Table 4 exhibits the results of the Intra-Germany quasi-natural experiment using reduced models. I either include no control variables or vary between $logNetA_{it}$, M/B_{it}, $CFsd_{it}$, and $Capx_{it}$.

Table 4 Reduced Intra-Germany Difference-in-Differences regression

This table presents results from the replication of table 3 with a reduced model. The model compares untreated German firms that adopted long-term incentives before the VorstAG to German firms that introduced long-term incentives subsequent to the VorstAG. The dependent variable, absolute abnormal cash holdings, as well as all moderating variables are explained in section 3.2. Standard errors are heteroskedasticiy-robust and clustered by time and industry. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. All models include time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parantheses.

	Predicted Sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	-	-0.0172***	-0.0121**	-0.0182***	-0.0176***	-0.0152**	-0.0147**	-0.0185***	-0.0157**
		(-2.84)	(-2.05)	(-2.99)	(-2.74)	(-2.58)	(-2.41)	(-2.87)	(-2.54)
treated		0.00850**	0.00577	0.00909**	0.00844**	0.00764*	0.00707*	0.00899**	0.00761*
		(2.16)	(1.44)	(2.28)	(2.04)	(1.88)	(1.74)	(2.15)	(1.83)
logNetA			-0.00439***			-0.00588***	-0.00568***		-0.00563***
			(-5.24)			(-8.41)	(-8.03)		(-7.91)
M/B					0.00404***		0.00366***	0.00390***	0.00353***
					(3.82)		(3.54)	(3.69)	(3.42)
CFsd			0.200***						
			(3.08)						
Capex				-0.153***		-0.146***		-0.143***	-0.137***
				(-3.26)		(-3.13)		(-3.05)	(-2.94)
Constant		0.0951***	0.108***	0.102***	0.0867***	0.133***	0.118***	0.0932***	0.124***
		(43.47)	(14.76)	(29.29)	(28.66)	(23.88)	(22.14)	(22.31)	(19.74)
Time fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
#observations		1546	1546	1546	1546	1546	1546	1546	1546
R-sq		0.007	0.047	0.015	0.021	0.042	0.047	0.028	0.053
Adj. R-sq		0.006	0.044	0.013	0.019	0.040	0.044	0.025	0.050

This reveals that the VorstAG reduces the variability of cash holding policies in the reduced models and confirms the results in tables 3. The reduced form models only investigate the overall effect of the VorstAG and are unable to explore the path on which the regulation affects the persistence of cash holding policies because CH_{it} is dropped.

4.3 Placebo Testing

A further concern that is already raised when figure 1 is discussed is a potential violation of the assumption of parallel trends. A difference-in-differences analysis assumes that the treatment and control group develop in a parallel trend during the pre-treatment period. On this basis both groups are predicted to continue this parallel trend in absence of the treatment, i.e. the treatment is the reason for diverging trends during the post-treatment period. The parallelism can be tested formally by undertaking a placebo test. This means focusing exclusively on the pre-treatment period and introducing a placebo treatment during this period.

I restrict my sample to the time-period from 2006-2008 and assume a placebo treatment to become effective in 2008. In the first step, I use the reduced models from table 4 for placebo testing. Table 5 exhibits the associated results which reveal no significant effect of the placebo treatment. This provides a confirmation of the parallel trends assumption. The effect of the VorstAG found in tables 3 and 4 does not coincide with an ex-ante difference between the treated German firms and EarlyLTI firms.

Table 5 Reduced Placebo Difference-in-Differences Regression

This table presents results from the replication of table 9 but uses a different definition of the pre- and post-treatment period. The smaple period is 2006 to 2008 and excludes the real post-treatment periods (2009-2015). The placebo treatment is assumed to occur in 2008. The placebo pre-treatment periods is 2006-2007 and the post-treatmentperiod embraces 2008. The dependent variable, absolute excess cash holdings, as well as all moderating variables are explained in section 3.2. Column 2 incorporates the interaction of cash holdings and the difference-in-differences effect. Standard errors are heteroskedasticiy-robust and clustered by time and country. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. All models include time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parantheses.

	Predicted Sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DiD	-	0.00794	0.0104	0.0108	0.00982	0.0108	0.0107	0.0125	0.0127
		(0.45)	(0.73)	(0.63)	(0.53)	(0.72)	(0.68)	(0.70)	(0.81)
treated		-0.00454	-0.00951	-0.00821	-0.00582	-0.0103	-0.00916	-0.00933	-0.0116
		(-0.53)	(-1.42)	(-1.02)	(-0.63)	(-1.55)	(-1.21)	(-1.08)	(-1.62)
logNetA			-0.00722***			-0.00814***	-0.00893***		-0.00819***
			(-10.19)			(-9.47)	(-13.09)		(-10.09)
M/B					0.00133		0.00152	0.00119	0.00140
					(1.19)		(1.15)	(1.04)	(1.07)
Capex				-0.220***		-0.171**		-0.219***	-0.168**
				(-3.22)		(-2.32)		(-3.23)	(-2.34)
CFsd			0.175***						
			(3.78)						
Constant		0.0954***	0.123***	0.107***	0.0931***	0.147***	0.139***	0.105***	0.144***
		(22.21)	(23.01)	(16.11)	(21.24)	(24.63)	(26.26)	(15.46)	(24.65)
Time fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
#observations		453	453	453	453	453	453	453	453
R-sq		0.002	0.066	0.024	0.003	0.066	0.055	0.026	0.068
Adj. R-sq		-0.003	0.057	0.018	-0.003	0.058	0.047	0.017	0.058

Table 6 Full Placebo Difference-in-Differences Regression

This table presents results from the replication of table 3 but uses a different definition of the pre- and post-treatment period. The smaple period is 2006 to 2008 and excludes the real post-treatment periods (2009-2015). The placebo treatment is assumed to occur in 2008. The placebo pre-treatment periods is 2006-2007 and the post-treatmentperiod embraces 2008. The dependent variable, absolute abnormal cash holdings, as well as all moderating variables are explained in section 3.2. Column 2 incorporates the interaction of cash holdings and the difference-in-differences effect. Column 3-4 add squared cash holdings to the model to account for the potential non-linear influence of the level of cash on absolute abnormal cash holdings. Standard errors are heteroskedasticiy-robust and clustered by time and industry. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. All models include time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parantheses.

	Predicted Sign	(1)	(2)	(3)	(4)
DiD	-	-0.000732	0.000475	0.00263	0.00397
		(-0.09)	(0.04)	(0.32)	(0.31)
CH*did	-		-0.0596**		-0.0493***
			(-2.27)		(-3.48)
treated		-0.000970	-0.00100	-0.00605	0.00555
		(-0.18)	(-0.18)	(-0.99)	(0.77)
CH	+	0.0329	-0.000335	-0.383***	-0.404***
		(0.96)	(-0.01)	(-4.28)	(-4.72)
CH*VorstAG			0.0602**		0.0556*
			(2.20)		(1.79)
CH*treated			0.0293*		-0.0466**
			(1.89)		(-2.71)
CH^2				0.652***	0.689***
				(7.27)	(7.20)
logNetA		-0.00105	-0.000750	-0.00357**	-0.00274*
		(-0.67)	(-0.50)	(-2.70)	(-1.99)
Lev		-0.160***	-0.168***	-0.153***	-0.166***
		(-5.41)	(-5.91)	(-4.54)	(-5.06)
Capex		-0.121*	-0.116*	-0.0846	-0.0761
		(-1.93)	(-1.82)	(-1.46)	(-1.36)
Div		0.191*	0.168	0.138**	0.113
		(1.85)	(1.21)	(2.38)	(1.14)
EBIT		-0.108***	-0.109***	-0.0745***	-0.0719***
		(-3.99)	(-4.00)	(-3.60)	(-3.57)
NWC		-0.130***	-0.128***	-0.134***	-0.136***
		(-4.74)	(-4.40)	(-4.79)	(-4.60)
R&D		-0.0177	-0.0296	0.0183	0.00241
		(-0.20)	(-0.32)	(0.26)	(0.04)
M/B		0.00217*	0.00261**	0.00195*	0.00239**
		(1.89)	(2.19)	(1.96)	(2.15)
CFsd		0.0415	0.0436	0.0973*	0.125**
		(0.69)	(0.77)	(1.80)	(2.48)
Constant		0.192***	0.194***	0.227***	0.225***
		(10.61)	(10.75)	(7.78)	(8.24)
Time fixed effects		*Yes*	*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*	*Yes*
#observations		453	453	453	453
R-sq		0.310	0.315	0.433	0.444
Adj. R-sq		0.291	0.291	0.416	0.424

I repeat the placebo test with the full models based on table 3. Results are exhibited in table 6. Again, DiD_{it} does not have an effect on $AbsAbnCH_{it}$ in any of the model specifications. The interaction $CH * did_{it}$ decreases $AbsAbnCH_{it}$. However, the full effect of the VorstAG is captured by aggregating the effect of DiD_{it} and $CH * did_{it}$ which does not yield a significant influence on $AbsAbnCH_{it}$ as column 1 shows. Thus, this provides further indications for the absence of a violation of the parallel trends assumption.

4.4 Robustness of Matching

A central factor that influences the results of this investigation is the matching procedure's specification. I report results for the most cautious set-up of the propensity score matching, using a caliper of 0.01, no replacement and applying the common support condition. In an analysis of robustness, I test numerous variants of the specification set-up for the models used in table 3: First, employing the common support condition and not allowing replacement. Second, prohibiting replacement as well as not introducing the common support condition. Third, allowing replacement and using the common support condition. Fourth, allowing replacement and not using the common support requirement. All specifications are tested for different calipers: 0.01, 0.02, 0.05, and 0.99. The caliper specification of 0.99 essentially means not requiring the matches to lie within a specific caliper. Table 7 tabulates the results of the described analysis of robustness. The observation that the VorstAG overall decreases $AbsAbnCH_{it}$, which means increasing the

persistence of cash holding policies, as well as the negative influence of the VorstAG on the association between the level of cash and absolute abnormal cash holdings is found consistently throughout the vast majority of different variants of the matching procedure. The results hold for the most conservative calipers (0.01 and 0.02). Some associations become less significant when the caliper is further relaxed (0.05 and 0.99) which means including worse matches.

Table 7 Robustness of Matching Specification

This table presents results of testing how the the matching procedure's specification influences the results of the differene-in-differneces regression in table 5. The table exhibits the coefficients and t-value of DiD and CH*did, obtained from the model specificied in table 3. DiD is obtained from a replication of the column 1 in table 3. CH*did is obtained from a replication of column 2 in table 3. The columns of table 7 indicate different calipers that were used during the matching procedure of the replication. The lines indicate differences in the application of the common support requirement and in allowing the multiple usage of international firms as matches. Standard errors are heteroskedasticiy-robust and clustered by time and country. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. The underlying regression model includes time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parentheses.

caliper		0.01	0.02	0.05	0.99
Common support requirement, no replacement	DiD	-0.0135***	-0.0109**	0.0124***	-0.0115**
		(-2.71)	(-2.01)	(3.60)	(-2.15)
	CH*did	-0.155***	-0.172***	0.0152	-0.157***
		(-3.58)	(-3.33)	(0.93)	(-3.11)
No common support requirement, no replacement	DiD	-0.0138***	-0.00983*	-0.0111**	-0.0113**
		(-2.82)	(-1.89)	(-2.21)	(-2.18)
	CH*did	-0.158***	-0.188***	-0.152***	-0.150***
		(-3.72)	(-3.71)	(-3.21)	(-3.09)
Common support requirement, with replacement	DiD	-0.0148***	-0.0123**	-0.00949	-0.0111*
		(-2.64)	(-2.04)	(-1.53)	(-1.82)
	CH*did	-0.192***	-0.229***	-0.241***	-0.236***
		(-4.29)	(-4.65)	(-4.95)	(-4.94)
No common support requirement, with replacement	DiD	-0.0135***	-0.00837	-0.0111**	-0.0115**
		(-2.71)	(-1.35)	(-2.16)	(-2.15)
	CH*did	-0.155***	-0.248***	-0.148***	-0.157***
		(-3.58)	(-5.02)	(-3.10)	(-3.11)

5. Are more persistent cash holding policies always beneficial?

The previous analysis assumes that more persistent cash holding policies are generally beneficial. It is unclear if there is an optimal level of persistence, i.e. if having a too persistent cash holding policy can harm the value of cash and firm value. I investigate this question by applying the classic value-of-cash model by Pinkowitz/Williamson (2006) depicted in eq. (3):

$$\frac{M}{B}_{\text{it}} = \beta_0 + \beta_1 \times CH_{it} + \beta_2 \times AbsAbnCH_{it} + \beta_3 \times AbsAbnCH_{it} * CH_{it}$$
$$+\beta_4 \times \Delta\frac{M}{B}_{it+1} + \beta_5 \times EBIT_{it} + \beta_6 \times \Delta EBIT_{it} + \beta_7 \times \Delta EBIT_{it+1} + \beta_8 \times \Delta logNetA_{it}$$
$$+\beta_9 \times \Delta logNetA_{it+1} + \beta_{10} \times R\&D_{it} + \beta_{11} \times \Delta R\&D_{it} + \beta_{12} \times \Delta R\&D_{it+1} + \beta_{13} \times Div_{it}$$
$$+\beta_{14} \times \Delta Div_{it} + \beta_{15} \times \Delta Div_{it+1} + \beta_{16} \times IntExp_{it} + \beta_{17} \times \Delta IntExp_{it} + \beta_{18} \times \Delta IntExp_{it+1}$$
$$+\beta_{19} \times FF12Ind_{it} + \beta_{20} \times FYear_{it} + \varepsilon_{it} \quad (3)$$

This model is estimated for all listed German firms from 2006-2015. The VorstAG-setting is not employed because the introduction of the regulation only changes the persistence of cash holding policies but not how investors perceive persistent cash holdings. All variables are obtained from Compustat Captial IQ Global and calculated as defined in section 3.2. $IntExp_{it}$ equal interest (XINT) expenditures scaled by total assets. The prefix Δ indicates a change variables. Thus, $\Delta X_{it} = X_{it} - X_{it-1}$ and $\Delta X_{it+1} = X_{it+1} - X_{it}$.

Table 8 The Value of Cash and Absolute Abnormal Cash

This table presents results from the value-of-cash model based on Opler/Pinkowitz (2007) introduced in section 5, eq. (3). The dependent variable, which is the market-to-book ratio, and all explanatory variables are defined in section 5 and section 3.2. Standard errors are heteroskedasticity-robust and clustered by time and industry. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. All models include time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parantheses.

	Predicted Sign	(1)	(2)	(3)
CH_t	-	0.605*	0.343	1.611***
		(1.78)	(1.01)	(3.33)
$AbsAbnCH_t$	-		1.491***	3.216***
			(3.33)	(3.72)
$AbsAbnCH * CH_t$				-7.225***
				(-2.75)
dM/B_{t+1}		-0.539***	-0.537***	-0.537***
		(-7.82)	(-7.85)	(-7.88)
$Ebit_t$		-1.777**	-1.643**	-1.529**
		(-2.61)	(-2.43)	(-2.27)
$dEbit_t$		3.155***	3.183***	3.115***
		(3.87)	(3.91)	(3.81)
$dEbit_{t+1}$		2.958***	3.050***	3.133***
		(3.98)	(4.17)	(4.31)
$dlogNetA_t$		0.590**	0.597**	0.588**
		(2.15)	(2.22)	(2.18)
$dlogNetA_{t+1}$		1.169***	1.167***	1.128***
		(3.43)	(3.42)	(3.29)
$R\&D_t$		7.500***	7.638***	7.455***
		(6.36)	(6.45)	(6.09)
$dR\&D_t$		-3.705*	-3.598*	-3.777*
		(-1.74)	(-1.73)	(-1.79)
$dR\&D_{t+1}$		0.168	0.310	0.407
		(0.08)	(0.15)	(0.20)
Div_t		24.21***	23.79***	23.45***
		(13.06)	(12.65)	(12.45)
$dDiv_t$		-4.325*	-4.466*	-4.270*
		(-1.84)	(-1.87)	(-1.79)
$dDiv_{t+1}$		10.52***	10.02***	10.74***
		(4.04)	(3.73)	(4.15)
$IntExp_t$		25.29***	25.46***	27.95***
		(6.77)	(6.80)	(7.27)
$dIntExp_t$		2.463	2.293	2.025
		(0.46)	(0.43)	(0.38)
$dIntExp_{t+1}$		22.58***	22.49***	23.97***
		(3.04)	(3.01)	(3.20)
Time fixed effects		*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*
#observations		3318	3318	3318
R-sq		0.303	0.305	0.308
Adj. R-sq		0.296	0.298	0.300

Table 8 tabulates results for the application of the value-of-cash model presented in eq. 3 on the full sample of listed German firms. Column 1 represents the standard model according to Pinkowitz/Williamson (2006). Column 2 adds $AbsAbnCH_{it}$ to the model and column 3 includes the interaction term $AbsAbnCH * CH_{it}$. Column 1 corresponds to the general notion in the literature and reports the value of cash to be smaller than 1. This indicates that cash holdings destroy firm value. The significant effect of CH_{it} is lost in column 2 which shows that the overall effect of the cash level depends on the persistence of cash holdings policies. Including the interaction term in column 3 disentangles this association further. $AbsAbnCH_{it}$ affects firm value positively, while $AbsAbnCH * CH_{it}$ features a negative coefficient. This points out that $AbsAbnCH_{it}$ does not have a negative association with firm value in general. Instead, $AbsAbnCH_{it}$ is negatively associated with the market value of cash, i. e. more variable cash holding policies reduce the value of the cash stock.

Table 9 separates the sample in 10 sub-samples that correspond to the yearly level of $AbsAbnCH_{it}$. Columns 1-3 contain firms with $AbsAbnCH_{it}$ smaller or equal to the 10th percentile. Columns 4-6 regard a sub-sample consisting of firms with $AbsAbnCH_{it}$ smaller or equal to the 20th percentile but larger than the 10th percentile. Columns 7-9 focus on firms with $AbsAbnCH_{it}$ smaller or equal to the 30th percentile but larger than the 20th percentile, etc. Columns 4-6 and column 28 show a negative coefficient for CH_{it}. In contrast, columns 7-9 exhibit a positive coefficient for CH_{it}.

Table 9 The Value of Cash and Percentiles of Absolute Abnormal Cash

This table presents results from the value-of-cash model based on Opler/Pinkowitz (2007) introduced in section 5, eq. (3) and employed in table 8 for different sub-samples of German firms from 2006-2015. German firms are grouped by their yearly level of AbsAbnCH. Accordingly, column (1)-(3) contain firms exbhiting AbsAbnCH smaller or equal to the 10th percentile. Column (4)-(6) contain firms exbhiting AbsAbnCH smaller or equal to the 20th percentile but larger than the 10th percnetile. Column (7)-(9) contain firms exbhiting AbsAbnCH smaller or equal to the 30th percentile but larger than the 20th percnetile, etc. The dependent variable, which is the market-to-book ratio, and all explanatory variables are defined in section 5 and section 3.2. Standard errors are heteroskedasticity-robust and clustered by time and industry. The corresponding t-statistics are derived via pair cluster bootstrapping as suggested by Bertrand et al. (2004), Cameron et al. (2008), and Harden (2011) for studies with few clusters. All models include time and industry fixed effects. ***, **, and * indicate significance at the 0.01, 0.05, and 0.1 levels, t-values are shown in parantheses.

Percentiles of AbsAbnCH		10%			20%			30%			40%			50%		
	Predicted Sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
CH_t	-	1.745	1.955	1.625	-2.497**	-2.655**	-11.40***	1.638**	1.584**	-5.255	-1.119	-1.332	-8.553	1.780	1.772	-1.568
		(1.43)	(1.65)	(0.81)	(-2.10)	(-2.13)	(-3.21)	(2.61)	(2.50)	(-1.56)	(-1.05)	(-1.26)	(-1.39)	(1.59)	(1.59)	(-0.14)
$AbsAbnCH_t$	-		-24.76	-29.90		-16.39	-61.73***		4.717	-24.85		18.96**	-0.105		7.876	0.416
			(-1.62)	(-1.18)		(-1.13)	(-2.83)		(0.54)	(-1.45)		(2.00)	(-0.01)		(0.63)	(0.02)
$AbsAbnCH * CH_t$				41.41			445.8***			196,9**			144.1			51.32
				(0.30)			(3.31)			(2.28)			(1.20)			(0.32)
dM/B_{t+1}		-0.214	-0.211	-0.211	-0.176	-0.187	-0.164	-0.206	-0.198	-0.192	-0.325	-0.328	-0.323	-0.501***	-0.500***	-0.499***
		(-1.51)	(-1.48)	(-1.48)	(-1.10)	(-1.11)	(-1.02)	(-1.17)	(-1.11)	(-1.08)	(-1.45)	(-1.47)	(-1.43)	(-4.29)	(-4.29)	(-4.27)
$Ebit_t$		1.126	1.052	1.072	3.004**	3.045**	2.880**	3.474**	3.502***	3.703***	-1.623	-1.892	-1.913	-11.06***	-11.08***	-11.00***
		(0.59)	(0.55)	(0.56)	(2.42)	(2.48)	(2.31)	(2.63)	(2.67)	(3.39)	(-0.98)	(-1.12)	(-1.15)	(-6.51)	(-6.51)	(-6.40)
$dEbit_t$		1.755	1.508	1.492	-2.600	-2.574	-2,113	-2.409	-2.427	-2.131	4.101	4.213	4.219	0.814	0.723	0.670
		(1.04)	(0.84)	(0.83)	(-1.19)	(-1.18)	(-0.96)	(-1.40)	(-1.41)	(-1.23)	(1.43)	(1.48)	(1.49)	(0.63)	(0.55)	(0.51)
$dEbit_{t+1}$		0.848	0.625	0.700	-2.980*	-3.022*	-2.594*	0.667	0.649	0.771	8.929**	8.693**	8.541**	-5.853**	-5.908**	-5.872**
		(0.36)	(0.27)	(0.31)	(-1.92)	(-1.94)	(-1.73)	(0.68)	(0.67)	(0.83)	(2.15)	(2.09)	(2.06)	(-2.46)	(-2.50)	(-2.46)
$dlogNetA_t$		0.245	0.341	0.344	-0.240	-0.242	-0.0725	0.589*	0.579	0.507	-0.315	-0.389	-0.441	1.523**	1.525**	1.531**
		(0.24)	(0.34)	(0.34)	(-0.66)	(-0.65)	(-0.20)	(1.68)	(1.66)	(1.48)	(-0.57)	(-0.69)	(-0.77)	(2.39)	(2.37)	(2.38)
$dlogNetA_{t+1}$		0.863	0.908	0.899	1.924**	1.914**	1.758**	0.629	0.609	0.660	0.430	0.353	0.418	1.160**	1.148**	1.155**
		(1.12)	(1.16)	(1.14)	(2.44)	(2.44)	(2.28)	(1.04)	(1.00)	(1.09)	(0.56)	(0.46)	(0.54)	(2.39)	(2.36)	(2.38)
$R\&D_t$		-2.127	-2.283	-2.230	11.11***	11.07***	11.39***	4.156**	4.168**	3.663**	3.210*	3.635**	3.842**	8.871***	8.748***	8.719***
		(-1.07)	(-1.17)	(-1.12)	(3.34)	(3.33)	(3.39)	(2.15)	(2.16)	(2.06)	(1.84)	(2.10)	(2.23)	(2.94)	(2.90)	(2.88)
$dR\&D_t$		5.367	5.941	5.436	-8.455**	-8.317*	-11.09***	-4.034	-4.101	-3.674	2.615	1.968	1.730	-11.81***	-11.67***	-11.61***
		(0.72)	(0.82)	(0.70)	(-2.03)	(-1.95)	(-2.72)	(-1.41)	(-1.42)	(-1.25)	(0.42)	(0.30)	(0.27)	(-3.36)	(-3.32)	(-3.30)
$dR\&D_{t+1}$		0.815	1.019	0.823	-0.952	-1.131	-3.855	-5.772	-5.737	-4.269	6.348**	6.607**	7.889**	-15.98***	-15.99***	-15.94***
		(0.31)	(0.40)	(0.33)	(-0.31)	(-0.36)	(-1.12)	(-1.28)	(-1.30)	(-1.03)	(2.19)	(2.38)	(2.58)	(-2.75)	(-2.74)	(-2.72)
Div_t		16.47**	16.29**	16.40**	16.35***	16.84***	14.58***	21.01***	21.03***	21.94***	22.59***	23.90***	23.60***	32.44***	32.90***	33.08***
		(2.41)	(2.41)	(2.38)	(3.07)	(3.18)	(2.69)	(3.04)	(3.05)	(3.35)	(3.97)	(4.15)	(4.10)	(4.61)	(4.66)	(4.86)
$dDiv_t$		-35.59***	-34.84***	-34.89***	-14.61*	-13.52	-14.18*	-17.85*	-17.75*	-18.41*	-7.496	-8.479	-8.984	8.067	8.235	8.318
		(-8.21)	(-8.35)	(-8.31)	(-1.82)	(-1.65)	(-1.78)	(-1.81)	(-1.81)	(-1.89)	(-0.92)	(-1.05)	(-1.13)	(1.46)	(1.49)	(1.50)
$dDiv_{t+1}$		3.514	3.905	3.769	39.61***	39.74***	37.42***	12.68***	12.29***	12.05***	-12.13	-12.86	-14.36	17.95**	18.35**	18.91**
		(0.58)	(0.65)	(0.63)	(2.94)	(2.93)	(2.75)	(3.06)	(2.77)	(2.82)	(-1.17)	(-1.25)	(-1.45)	(2.39)	(2.42)	(2.57)
$IntExp_t$		-1.664	-0.381	-0.454	-2.083	-2.205	-2.431	22.88*	22.73*	22.06*	-5.749	-6.231	-6.425	18.06	18.46*	18.17
		(-0.19)	(-0.04)	(-0.05)	(-0.25)	(-0.27)	(-0.30)	(1.84)	(1.82)	(1.78)	(-0.52)	(-0.57)	(-0.59)	(1.66)	(1.69)	(1.61)
$dIntExp_t$		8.255	8.873	8.918	13.84	15.47	14.26	-2.834	-3.440	-1.865	21.11	17.27	17.14	18.06	18.50	18.55
		(1.30)	(1.31)	(1.32)	(1.19)	(1.27)	(1.22)	(-0.14)	(-0.18)	(-0.09)	(0.91)	(0.77)	(0.76)	(1.28)	(1.32)	(1.32)
$dIntExp_{t+1}$		19.68	20.97	21.08	-11.78	-12.06	-12.94	4.505	3.689	6.504	12.98	8.810	10.78	33.66	32.19	33.18
		(1.03)	(1.08)	(1.09)	(-1.12)	(-1.14)	(-1.20)	(0.29)	(0.23)	(0.41)	(0.61)	(0.42)	(0.50)	(1.20)	(1.14)	(1.17)
Constant		1.304***	1.428***	1.466***	1.390***	1.737***	2.681***	0.482**	0.331	1.340**	1.693***	0.790	1.735	1.234***	0.730	1.212
		(4.18)	(4.50)	(3.83)	(5.51)	(3.62)	(4.14)	(2.15)	(0.92)	(2.16)	(4.87)	(1.34)	(1.62)	(5.60)	(0.86)	(0.73)
Time fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
#observations		335	335	335	332	332	332	331	331	331	332	332	332	330	330	330
R-sq		0.329	0.333	0.333	0.332	0.334	0.346	0.356	0.356	0.365	0.235	0.240	0.243	0.496	0.497	0.497
Adj. R-sq		0.296	0.298	0.296	0.299	0.300	0.309	0.320	0.318	0.326	0.199	0.202	0.202	0.468	0.467	0.465

Table 9 Continued

Percentiles of AbsAbnCH		60%			70%			80%			90%			100%		
Predicted Sign		(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
CH_t	-	-0.357	-0.357	-7.785	0.267	0.369	-10.40	0.125	0.0559	17.04**	0.865	0.728	-16.47*	-1.951***	-1.397*	2.971
		(-0.41)	(-0.40)	(-0.76)	(0.33)	(0.49)	(-1.11)	(0.17)	(0.08)	(2.29)	(1.03)	(0.90)	(-1.70)	(-3.55)	(-1.70)	(0.88)
$AbsAbnCH_t$	-		0.0428	-11.42		27.11**	13.83		9.322	28.14***		9.818	-9.260		-3.492	4.253
			(0.00)	(-0.49)		(2.57)	(0.90)		(1.29)	(2.82)		(1.14)	(-0.62)		(-1.09)	(0.67)
$AbsAbnCH * CH_t$				92.87			107.9			-132.4**			106.4*			-16.23
				(0.76)			(1.14)			(-2.38)			(1.80)			(-1.37)
dM/B_{t+1}		-0.330	-0.330	-0.332	0.0711	0.0762	0.0672	-0.581***	-0.572***	-0.567***	-0.106	-0.106	-0.114	-0.334**	-0.355***	-0.350***
		(-0.96)	(-0.94)	(-0.94)	(0.96)	(1.08)	(0.96)	(-3.00)	(-2.92)	(-2.97)	(-0.70)	(-0.71)	(-0.79)	(-2.58)	(-2.78)	(-2.84)
$Ebit_t$		-3.885*	-3.885*	-3.875*	-1.609	-1.438	-1.684	2.780	2.859	2.845	-0.724	-0.560	-0.961	1.791	1.553	1.625
		(-1.71)	(-1.70)	(-1.68)	(-1.04)	(-0.94)	(-1.09)	(1.18)	(1.22)	(1.24)	(-0.65)	(-0.47)	(-0.80)	(0.83)	(0.72)	(0.75)
$dEbit_t$		7.122***	7.122***	7.017***	2.877	3.041	3.096	-2.072	-2.069	-2.380	0.547	0.616	0.613	4.214**	4.303**	4.106**
		(4.79)	(4.78)	(4.94)	(1.28)	(1.36)	(1.39)	(-1.01)	(-0.98)	(-1.14)	(0.29)	(0.33)	(0.32)	(2.33)	(2.33)	(2.27)
$dEbit_{t+1}$		6.102**	6.101**	5.813**	-3.803**	-3.985**	-4.106***	0.754	0.779	0.679	3.263**	3.450**	3.408**	-0.637	-0.847	-0.538
		(2.12)	(2.09)	(2.05)	(-2.52)	(-2.62)	(-2.68)	(0.58)	(0.59)	(0.54)	(2.53)	(2.56)	(2.46)	(-0.30)	(-0.40)	(-0.26)
$dlogNetA_t$		2.331**	2.331**	2.337**	-2.351**	-2.504***	-2.424**	0.810	0.810	0.849	-0.334	-0.204	0.0403	0.280	0.242	0.188
		(2.31)	(2.35)	(2.36)	(-2.64)	(-2.77)	(-2.63)	(1.29)	(1.27)	(1.40)	(-0.79)	(-0.44)	(0.09)	(0.39)	(0.34)	(0.27)
$dlogNetA_{t+1}$		0.324	0.323	0.344	1.009**	0.904**	0.956**	-1.285*	-1.355*	-1.344*	2.187***	1.992***	1.906***	0.0598	-0.0116	0.0202
		(0.58)	(0.64)	(0.68)	(2.16)	(2.05)	(2.16)	(-1.73)	(-1.87)	(-1.89)	(2.90)	(2.89)	(2.83)	(0.05)	(-0.01)	(0.02)
$R\&D_t$		1.770	1.769	1.729	6.698*	6.314	6.322*	5.760**	5.700**	5.763**	5.627**	5.686**	5.692**	13.29***	12.67***	12.12***
		(0.73)	(0.72)	(0.69)	(1.73)	(1.65)	(1.68)	(2.49)	(2.50)	(2.53)	(2.38)	(2.43)	(2.46)	(4.67)	(4.49)	(4.53)
$dR\&D_t$		-2.712	-2.711	-2.772	-3.915	-2.736	-2.639	-8.158	-7.397	-7.082	-4.225	-4.692	-4.304	-27.42***	-28.03***	-27.80***
		(-0.78)	(-0.76)	(-0.78)	(-0.71)	(-0.53)	(-0.52)	(-1.44)	(-1.34)	(-1.23)	(-0.80)	(-0.89)	(-0.85)	(-3.79)	(-3.82)	(-3.88)
$dR\&D_{t+1}$		4.012	4.012	3.856	16.01**	15.13**	14.61**	-12.91	-12.61	-12.23	3.957*	4.061*	4.332**	3.254	3.254	2.127
		(0.64)	(0.63)	(0.60)	(2.49)	(2.47)	(2.37)	(-1.49)	(-1.46)	(-1.45)	(1.92)	(1.98)	(2.14)	(0.69)	(0.73)	(0.46)
Div_t		32.24***	32.25***	32.88***	13.71**	13.34**	14.98**	20.68***	20.71***	21.26***	13.53***	11.96**	10.59*	9.595	10.17	9.343
		(4.31)	(4.27)	(4.33)	(2.12)	(2.07)	(2.51)	(3.29)	(3.24)	(3.54)	(2.68)	(2.09)	(1.84)	(1.54)	(1.56)	(1.45)
$dDiv_t$		-5.119	-5.119	-4.935	-23.27***	-24.12***	-24.65***	-4.371	-4.760	-4.841	-4.563	-3.212	-2.593	0.292	0.269	0.0411
		(-0.53)	(-0.52)	(-0.50)	(-4.43)	(-4.55)	(-4.67)	(-0.67)	(-0.74)	(-0.73)	(-1.00)	(-0.65)	(-0.55)	(0.06)	(0.06)	(0.01)
$dDiv_{t+1}$		-1.998	-2.000	-2.259	2.010	1.235	1.050	7.320	7.741	7.831	12.35**	11.97**	10.50**	-0.00412	-0.281	-0.311
		(-0.20)	(-0.20)	(-0.22)	(0.55)	(0.34)	(0.29)	(1.45)	(1.55)	(1.56)	(2.45)	(2.38)	(2.24)	(-0.00)	(-0.05)	(-0.06)
$IntExp_t$		11.06	11.06	10.48	29.79**	30.59**	30.65**	19.61**	19.56**	21.86**	-0.542	-4.176	-3.830	43.74***	46.08***	49.20***
		(1.14)	(1.15)	(1.05)	(2.40)	(2.44)	(2.42)	(2.24)	(2.25)	(2.51)	(-0.04)	(-0.27)	(-0.24)	(2.97)	(2.94)	(3.01)
$dIntExp_t$		19.97	19.97	19.89	-72.27**	-67.36**	-68.34**	22.50	24.55	23.48	10.06	15.15	11.18	9.353	6.359	7.556
		(0.92)	(0.92)	(0.93)	(-2.21)	(-2.12)	(-2.16)	(1.53)	(1.63)	(1.55)	(0.55)	(0.79)	(0.57)	(0.47)	(0.30)	(0.35)
$dIntExp_{t+1}$		-1.953	-1.957	-1.255	111.6***	112.0***	110.8***	8.831	7.305	4.545	19.57	20.03	6.846	27.56*	27.94*	33.82**
		(-0.07)	(-0.07)	(-0.04)	(3.09)	(3.16)	(3.09)	(0.56)	(0.48)	(0.30)	(1.15)	(1.15)	(0.31)	(1.70)	(1.75)	(2.08)
Constant		1.355***	1.352	2.273	1.219***	-1.485	-0.183	0.967***	-0.200	-2.651**	1.525***	0.0656	3.159	2.247***	2.965***	1.083
		(4.52)	(0.97)	(1.11)	(4.79)	(-1.48)	(-0.13)	(4.77)	(-0.23)	(-2.07)	(3.90)	(0.05)	(1.30)	(6.51)	(4.45)	(0.73)
Time fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Industry fixed effects		*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
#observations		334	334	334	332	332	332	330	330	330	333	333	333	329	329	329
R-sq		0.202	0.202	0.203	0.257	0.271	0.273	0.287	0.290	0.299	0.167	0.171	0.186	0.227	0.230	0.236
Adj. R-sq		0.162	0.159	0.158	0.220	0.233	0.233	0.252	0.253	0.260	0.121	0.123	0.136	0.185	0.185	0.189

This points out that the positive coefficient of CH_{it} for the aggregated sample that is found in table 8 column 1 is largely driven by the positive coefficient found in table 9 columns 7-9. Moreover, the negative coefficient of CH_{it} in table 9 columns 3-6, for the group of firms that feature $AbsAbnCH_{it}$ smaller or equal to the 20th percentile but larger than the 10th percentile, shows that cash holding policies can be too persistent. Moderate levels of $AbsAbnCH_{it}$ do not seem to affect the market value of CH_{it} as they do not exhibit any significant overall effects of CH_{it}.

6. Conclusion

This study shows that compensation incentives, which are contingent on long-term performance, are associated with long-term strategies in corporate cash management. Prior research has identified such persistent cash policies to increase the value of cash but did not provide means to induce persistence. Thus, this study contributes to existing research by identifying long-term incentives as a potential tool to motivate more persistent cash holding policies and prevent value destroying cash regimes. Long-term incentives are negatively associated with the positive association between the cash level and the variability of cash holding policies. This means long-term incentives are associated with the implementation of more long-term oriented cash holding policies in high-cash firms.

These results help assessing a real effect of a German regulation on incentive-based compensation as well as the potential effect of a similar proposed rule in the US. The

proposed rule by the SEC and other US agencies aims to avoid "inappropriate risks", leading to "material financial loss". Inappropriate risks-taking is especially tied to short-term incentives in executive compensation. Thus, the regulatory proposal is linked to motivating long-term strategic planning and increasing long-term incentives. A regulatory initiative in Germany, the Act on the Appropriateness of Management Board's Compensation (VorstAG), which became effective in 2009, shares several features with the proposed US rule. In general, the German regulation required executive compensation to be adequate and customary as well as to motivate a sustainable (long-term) corporate development. The VorstAG, forced all publicly listed German firms to adjust their managerial compensation contracts. Thus, the VorstAG enforced an increase of long-term incentives in the compensation structure of German firms and serves as a suitable setting to investigate the association of long-term incentives with the persistence of cash holding policies as well as to explore one implication of the proposed US rule.

Finally, this study contributes to research on executive compensation in general by identifying a real effect of long-term incentives and by addressing some of the endogeneity issues affecting prior research. I exploit the VorstAG as a mandatory shock to long-term incentives. This lowers the problem of self-selection that affects prior studies focusing on the voluntary adoption of long-term incentives and allows more causal inferences. I match treated German firms with German firms that used long-term incentives before the VorstAG became effective (EarlyLTI). EarlyLTI firms are unaffected by the VorstAG because

they did not have to adjust their compensation structures. I compare the persistence of cash holding policies of the matched pairs in a difference-in-differences analysis. First, this reveals a general increase in the persistence of cash holding policies in treated Non-EarlyLTI firms after the VorstAG regulation becomes effective. Second, this result is especially driven by a decreasing association between the level of cash and the variability of cash holding policies.

Overall, my results provide implications for the design of compensation contracts that are relevant to shareholders, regulators, and managers. Increasing the persistence of cash management policies increases the market value of cash, as previous research points out. Such a persistent long-term policy in cash management is associated with long-term compensation incentives, as they are introduced by the VorstAG in Germany. Thus, the study emphasizes a real effect of the VorstAG and a real effect of adopting LTIs in general, which is not only important for the German regulator and German companies but all firms. Moreover, this observation helps to assess a proposed rule on incentive-based compensation in the US, which shares several characteristics with the VorstAG.

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